Second graders' collaborative learning around touchscreens in their classroom

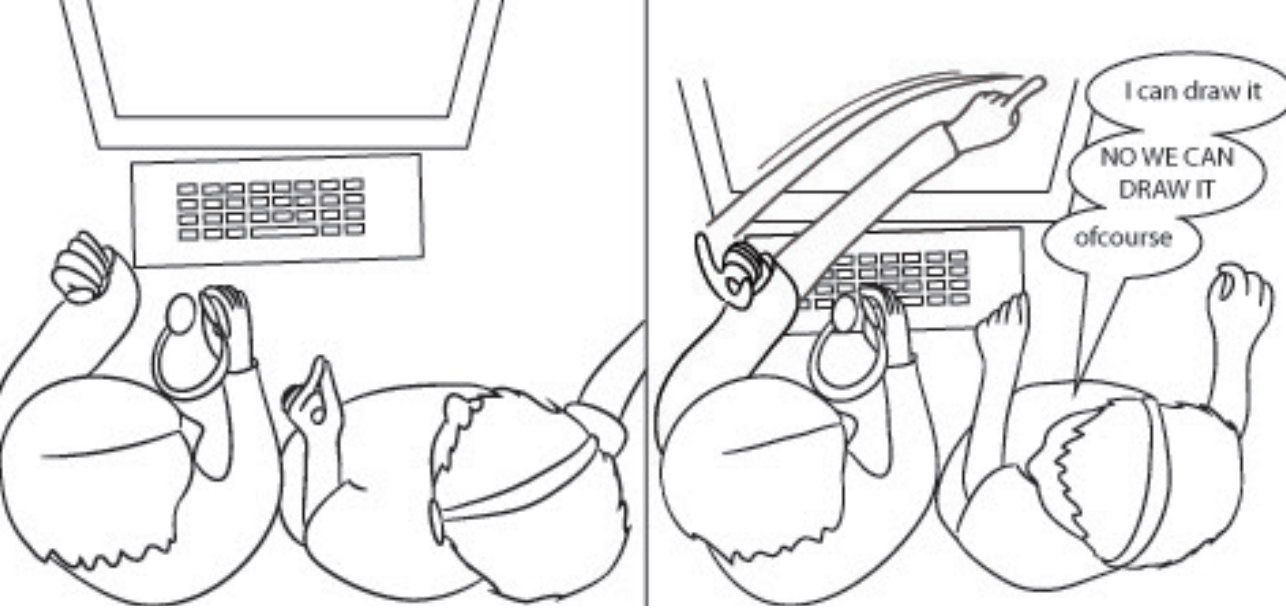
Micro-studies of eight and nine year old children's embodied collaborative interactions in front of a touchscreen

Davidsen, Jacob

DOI (link to publication from Publisher):
10.5278/vbn.phd.hum.00030

Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record



SECOND GRADERS' COLLABORATIVE LEARNING AROUND TOUCHSCREENS IN THEIR CLASSROOM

MICRO-STUDIES OF EIGHT AND NINE YEAR OLD CHILDREN'S EMBODIED COLLABORATIVE INTERACTIONS IN FRONT OF A TOUCHSCREEN

Part 1

BY
JACOB DAVIDSEN

DISSERTATION SUBMITTED 2014

AALBORG UNIVERSITET

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Dissertation submitted July 31, 2014

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PhD Series:	PhD Series, Faculty of Humanities, Aalborg University

ISSN: 2246-123X
ISBN: 978-87-7112-155-1

Published by:
Aalborg University Press
Skjernvej 4A, 2nd floor
DK – 9220 Aalborg Ø
Phone: +45 99407140
aauf@forlag.aau.dk
forlag.aau.dk

Printed in Denmark by Rosendahls, 2014

CV

Jacob Davidsen received his Master in Human Centred Informatics from Aalborg University in 2010. He started as a PhD student at the Department of Communication and Psychology at Aalborg University in Denmark in 2011. Davidsen is affiliated with the eLearning Lab (eLL) – Center for User Driven Innovation, Learning and Design and is a core member of eLL's design lab. His research interests are in the fields of human-computer interaction, learning sciences, and embodied and multimodal interaction analysis. He publishes on these topics in international and Scandinavian journals and teaches in subjects including "ICT, Collaboration and Learning" and "Interaction Analysis". Davidsen is methodologically experienced in qualitative research methods, especially in micro-multimodal and embodied interaction studies. In his PhD thesis, Jacob studied second graders' embodied, co-operative, moment-to-moment interactions around touchscreens in their classroom.

RESUME IN ENGLISH

In this thesis, I explore, analyse and discuss how eight- and nine-year-old children's embodied collaborative interactions around touchscreens unfold. Having conducted micro-studies on children's embodied collaborative interactions around touchscreens, I have found that children's body movements and, in particular, their hand movements, are crucial for their collaborative activities around touchscreens. The data comprise 150 hours of video footage and ethnographic observations, all from a yearlong study of naturally occurring activities in two different second grade classrooms at a public school in Denmark.

The thesis is paper based, meaning that it contains two separate parts: Part 1, in which I present the outcome of my research, first as a portrait of my research journey, and then as a summary of my findings and their scientific validity; and Part 2 – a separate publication – which contains five research papers selected as the most significant presentations of my work. The five papers are micro-studies of children's embodied collaborative interactions, which, among other things, shows how I have developed my method of working with video footage, the process and product of transcription, representation and analysis of video recordings of naturally occurring, embodied collaborative interactions.

My research concerns seeing and making visible what children do around touchscreens—or, more precisely, *how children do what*. In this endeavour, I am informed by computer-supported collaborative learning (CSCL), ethnomethodology (Garfinkel, 1967) and embodied interaction analysis (Streeck, Goodwin, & LeBaron, 2011b). This way of seeing and making visible children's embodied collaborative interactions around touchscreens stands in contrast to the main body of related research on collaboration and touch technology, in which research findings are based on coding and on counting children's interactions. While such studies provide knowledge about behaviour on a general level, my way-of-seeing and making-visible provides knowledge about the moment-to-moment embodied meaning-making unfolding around the touchscreen. The difference between knowledge of behaviour and knowledge of embodied meaning-making, which I outline in Part 1, has implications for politicians' decisions regarding technology investments in schools, as well as their decisions regarding the ways in which outcomes of collaborative learning are to be tested and measured. More concretely, in teachers' education, as well as in the everyday professional lives of teachers (as I show in Papers III and IV), it is important to know the difference between knowledge of behaviour and knowledge of embodied meaning-making when it comes to learning and interaction with digital technologies.

I see my research as part of the field of CSCL, where my micro-studies contribute findings regarding children's embodied practices of moment-to-moment co-operation of collaborative activities around touchscreens.

RESUME PÅ DANSK

I denne afhandling undersøger, analyserer og diskuterer jeg, hvordan børn igennem deres krop og sprog interagerer i forbindelse med samarbejde omkring en touchskærm. Min forskning er baseret på 150 timers videooptagelse og etnografiske observationer fra et års studier af naturligt forekommende aktiviteter i to anden klasser på en folkeskole i Danmark. Med afsæt i mikrostudier af disse videooptagelser, har jeg fundet frem til, at børns bevægelser, og i særdeleshed deres håndbevægelser, har stor indflydelse på udviklingen af samarbejdet omkring touchskærmene.

Afhandlingen er artikelbaseret og indeholder to separate dele. I Del 1 præsenterer jeg perspektiverne af min forskning - først som en autoetnografisk rejse og dernæst som et resume af mine resultater og deres videnskabelige validitet. Del 2 indeholder fem forskningsartikler, jeg har udvalgt, som de mest signifikante for min forskningsrejse. Igennem artiklerne viser jeg, hvordan jeg har udviklet min måde at arbejde med videooptagelser, både i forhold til proces og det endelige produkt af transskriptioner, repræsentationer og analyser af børns naturligt forekommen samarbejdsinteraktioner foran touchskærme. De fem artikler er sammensat i en separat publikation.

I min forskning er jeg inspireret af feltet computer-supported collaborative learning (CSCL), ethnomethodologien (Garfinkel, 1967) og "embodied interaktionsanalyse" (Streeck, Goodwin & LeBaron, 2011b). Med afsæt i disse traditioner har jeg arbejdet med en måde at iagttage og synliggøre børns samarbejde omkring touchskærme, som står i kontrast til store dele af den relaterede forskning om samarbejde og touchteknologi, hvor resultater primært er baseret på kodning og optælling af børnenes interaktion. Min forskning viser, at kodnings- og optællingsstudierne bidrager med viden om adfærd mere generelt, hvorimod min måde at iagttage og synliggøre på tilfører viden om, hvordan børn skaber mening sammen omkring touchskærme gennem krop og sprog. Det er min overbevisning, at mine resultater kan få betydning for politikeres beslutninger om investering i teknologien i skolen, og når det skal besluttes, hvordan læring kan testes og måles. Mere konkret, har det indflydelse på læreruddannelsen, og i særdeleshed på læreres professionelle liv (som jeg viser i artiklerne III og IV), hvor det synes vigtigt at kende og forstå forskellen mellem viden om overordnet adfærd og viden om "embodied" meningsdannelse, når det drejer sig om det større perspektiv inden for læring og interaktion omkring digitale læringsteknologier.

Min forskning er forankret i forskningsfeltet CSCL, og mine mikrostudier bidrager med perspektiver på, hvordan børn igennem deres krop og sprog interagerer i forbindelse med samarbejde omkring en touchskærm.

ACKNOWLEDGEMENTS

I have often been told that becoming and being a PhD student is a matter of apprenticeship in an academic community of practice, in which you learn how to become a researcher by seeing and following how other (senior) researchers work. Throughout my project, I have been a part of a stimulating community: the e-Learning Lab – Center for User Driven Innovation, Learning and Design at the Department of Communication and Psychology, Aalborg University. Here, I have participated in projects, teaching and discussions, and I am grateful for the opportunity to develop and grow here as a researcher. I have inherited many habits from my senior colleagues, although I have also wandered in other directions – tweaking the habits of the oldies as a newbie.

Marianne Georgsen guided me in my pre-PhD work and in the first year of my PhD project. We have had many positive, inspiring and fruitful discussions. From Marianne, I have learned much about being a researcher; in fact, Marianne taught me the very fundamentals of doing research. I also wrote the paper "ICT as a tool for collaboration in the classroom – Challenges and lessons learned" with Marianne.

Ellen Christiansen, my principal supervisor, has guided me through stormy weather and been an inspiration throughout the project. We have had many discussions on a variety of themes: theory, method, philosophy, gardening and bread baking. You have kept me awake all night with your thought-provoking questions and comments. Your insightful suggestions have enriched Part 1 in ways that are hard to describe. I am forever grateful for our collaboration. Together with Ellen, I wrote "The benefits of single-touchscreens in intersubjective meaning making" and "Mind the hand: A study on children's embodied and multimodal collaborative learning around touchscreens".

Ruben Vanderlinde, at the department of Educational Studies at Gent University, has been my co-supervisor for almost two years. Thank you, Ruben, for your guidance and support. You have opened many doors to the academic community for me, thank you. Ruben and I met at the Computer Assisted Learning Conference in Manchester in 2011; since then, I have visited him twice at Gent University, and he has been at Aalborg University once. I hope we will continue to meet in the future for discussions, for paper writing and for strong beers from Belgium. Ruben is also co-author of two of my publications: "Exploring what touchscreens offer from the perspectives of children: Methodological challenges" and "Researchers and teachers learning together and from each other using video-based multimodal analysis". I also want to thank Ruben for arranging housing for me in Gent – staying with Edwin Hantson and Leen De Bie was truly a learning experience.

Although you are from another knowledge group at the department of Communication and Psychology, your door has always been open, Pirkko Raudaskoski. You have hosted video data sessions and seminars with Sigrid Norris, Curtis LeBaron and Charles and Marjorie H. Goodwin. Moreover, you have kindly engaged in discussions on ethnomethodology, embodiment and multimodality with me. Thank you, Pirkko – you are a great inspiration and a wonderful colleague. From Mattering, I also want to thank Antonia Lina Krummheuer and Malene Kjær.

Before I started my PhD, I was affiliated with the e-Learning Lab as a student worker, and my colleagues at eLL mean the world to me. A special thanks to Marianne Lykke for making eLL a stimulating academic environment, and also for taking my opinions *about things none of my business* into account. I feel at home at eLL, thanks to all of eLL's members. A special thanks to Ulla Konnerup, Thomas Ryberg, Marianne Würtz, Sarai Løkkegaard, Tanja Svarre, Per Mouritzen, PVKA, Ann Bygholm, Tom Nyvang, Anne Marie Kanstrup, PO Zander and Søren Lindhardt, and an extraordinary thanks to my roommates in 3.02 and 3.23.

A special thanks to the administrative staff for support and guidance. Joan, Lykke, Lisbeth, Hanne and Jeannette – thank you for being professional, good company and good fun.

Ann Bygholm, head of the Doctoral School of Humanities, involved me in the work of the doctoral board, and it has truly been insightful to take part in the meetings, discussion and decisions about doctoral education. Thanks for involving me.

In the summer break of 2011, I had several conversations with Ann Bygholm and Lone Dirckinck-Holmfeld regarding the funding of my PhD. Thanks for spending your holidays communicating through mail and telephone to make my PhD a reality. Likewise, I want to thank AAU MatchMaking, Obel Fonden and LB Fonden for financial support.

I would also like to thank Paola Valero for inviting me to participate in the meetings of the SMERG group at AAU.

Rasmus Raun Poulsen, student at Human Centred Informatics, worked on the pencil illustrations, and I am grateful for your work.

My deepest gratitude goes to all the teachers and children who helped to make the project "Move and Learn" happen, and I offer a special, big thank you to John Klesner for allowing me to be a part of the project. I hope we can continue collaborating in the future.

Finally, many warm thanks to my family and friends, especially my mother, father, brothers and sister for supporting me and for listening to my thoughts and troubles.

To my amazing girls, Katrine and Anna Ellinor.

Thank you, Katrine, for your patience, love and understanding through a stormy part of my life. Anna Ellinor has accompanied me in the final eight months of my PhD and has been a crucial reminder that there is more to life than books, paper writing and video analysis.

I will try to listen more carefully in the future and to minimise my use of "emhh" when you ask me something, Katrine.

I dedicate this work to my late grandfather, Martin Davidsen, who showed me the value of hard and skilled work.

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CHAPTER 1

Inhabiting a new practice

> Wayfaring, I believe, is the most fundamental mode by which living beings, both human and non-human, inhabit the earth. By habitation I do not mean taking one's place in a world that has been prepared in advance for the populations that arrive to reside there. The inhabitant is rather one who participates from within in the very process of the world's continual coming into being and who, in laying a trail of life, contributes to its weave and texture. These lines are typically winding and irregular, yet comprehensively entangled into a close-knit tissue.
>
> (Ingold, 2007, p. 81)

Ingold (2007, 2011) introduced the concept of wayfaring to illustrate the lived experience of being human and sketched the idea of life as a weave composed by multiple lines, overlapping and joining each other in webs of entanglement. This epistemology illustrates and enunciates learning, research, writing and design as dynamic lived processes occurring over time, in and through different environments, with other human beings, materials and tools. Thus, my research process is influenced by other researchers and by their histories and cultures with tools, objects and ways of doing. In other words, I inhabit and build upon a sociocultural heritage, consciously as well as unconsciously, when I present my research – not as a straightforward line or a process from A to B – but as an entanglement of winding and irregular lines.

LINES IN MY WAYFARING

In 2009, during the final year of my master's degree studies within the program of Human Centred Informatics, my academic life changed direction, as I became involved in a project called "Move and Learn" at Western State School in Denmark[1] (see Chapter 2). Western State School had applied for funding for sixteen 23-inch large single-touchscreens[2], which were to be integrated in two different second grade classrooms. Fortunately, the funding agency required that researchers took part in the project to investigate how the technology was being integrated into

[1] The names of the school, the children and the teachers have been changed to ensure their privacy and identities. In addition, every child's parent(s) signed a consent form, allowing the researchers to use the video footage for presentations and publications. The school administration handled this process and secured every signature.

[2] Hereafter, I refer to the 23-inch single-touchscreens as single-touchscreens or touchscreens.

teaching and learning activities. Together with my supervisor and colleague, Marianne Georgsen, I became involved in this innovative technology integration project. Previously, I had not been working with information and communication technology (ICT) or with learning in the context of the Danish primary school system. At that time, I was both nervous and intrigued by the prospect of working with children, and by the fact that I was supposed to grasp and understand their collaborative interactions in front of touchscreens. In that way, I entered my research domain without any preconceived understandings of what might take place in second grade classrooms and without any agenda for changing how to teach and learn the different subjects, how to collaborate or how to use the touchscreens. Basically, I had no interest in judging or evaluating the children's or teachers' everyday school lives. Instead, my primary interest was to understand the children's ways of collaborating around touchscreens and the teachers' ways of designing for and guiding the children's collaboration. In my master thesis (Davidsen, 2010), I explored the process of integrating the touchscreens into classroom practices by interviewing the children and teachers about their experiences of taking part in a technology integration project. Moreover, I transcribed and analysed video footage with one pair of children collaborating on the "Easter-material", capturing primarily their talk. In conclusion, this work shed light on how children create learning trajectories together though language and actions. On the basis of this work, I engaged in my PhD studies.

My first steps into research and practice

In the beginning of my engagement in the classrooms, I remember that I thought they were chaotic places to learn and teach – indeed, a challenging environment to be in, for both children and teacher. Nevertheless, I was impressed by the ways in which the teachers worked in this practice, trying to make room for learning and for the development of both the individual child and the collective. The lessons learned from being there changed and shaped my understanding of classroom interaction and orchestration. I began slowly to see routines in their everyday practices, and, gradually, I came to see the subtle differences that caused frustration and success in the classrooms. I saw how a new week started, how children and teachers prepared for lunch, how pairs engaged in collaborative activities, how teachers walked around the room to help pairs of children solving assignments, and how teachers' instructions could transform into collaborative learning activities. I came to see that learning to collaborate is an ongoing, dynamic, situated and relational process, something that is learned in moment-to-moment interaction. I learned from being there 21 full school days; from watching many hours of video footage from the classrooms; from seeing instruction and collaboration produced; from standing on the side; from talking with the children and the teachers; and from trying to be both a spectator and a participant in the everyday practice. Gradually, I obtained an understanding of how children *engage* and *disengage* in collaborative activities in front of a single-touchscreen in their classroom settings, seeing their embodied

practices, methods and participation frameworks (Goodwin, 2000b) unfold over time. In addition, I experienced how video can support both researchers and teachers in obtaining understandings of how children collaborate and can be guided in this process, through so-called video feedback sessions (see Papers III and IV). This served as a mutual learning activity, in which teachers and researchers learned together and from each other.

Touch and collaboration – The perfect fit?

In 2009, the project "Move and Learn" was innovative in terms of both the technology used and the pedagogical ideas applied and explored. The single-touchscreens were pioneering in themselves, as was the focus on eight- and nine-year-old children's collaboration around the technology. This particular technology should, supposedly, provide new rules and affordances for collaborative activities, which the children and teachers were to explore together in their everyday classroom activities. Exploring the affordances of touch technologies in practice – and in the hands of children and teachers – stands in contrast to studies that philosophize over touch and technology (Cranny-Francis, 2011; Manning, 2007) and to experimental laboratory studies of touchscreens for learning (see Chapter 5). For instance, Cranny-Francis (2011) addressed the social and cultural meanings of touch and argued that touch plays an essential role in experiencing and learning for individual human beings. The material and tactile dimensions of interacting with a historic artefact at a museum, according to Cranny-Francis (2011), augment both experience and learning for the individual. While taking an individual attitude towards touch, Cranny Francis neglected what Streeck (2013) referred to as intercorporeality, or bodily intersubjectivity, which seems central to the study of the affordances of touch technologies for facilitating collaborative learning. This is also the case of short-term (30 minutes to one day) experimental studies, which have maintained a focus on the individual (coding language and counting gestures), while omitting the bodily intersubjective dimension of being and collaborating together. In addition, such experimental studies have treated collaborative learning as a given concept, which is often measured by the outcome of the activity, while I focus on and take a perspective on collaboration as an emergent and an embodied moment-to-moment interactional phenomena.

During the PhD project period, when I have presented video footage, transcripts and representations from project "Move and Learn" at local seminars and international conferences, I have often been asked whether or directly told that a multi-touchscreen would be much better suited for supporting children's collaboration. "Yes, of course," I thought in the beginning, but after having time to ponder on the matter, I have come to the conclusion that multi-user technology might not always better serve the process of collaboration and that more research is needed in order to judge these claims. In particular, more research showing how children engage and disengage in moment-to-moment collaborative interactions around touchscreens

seems important in order to qualify and inform decisions regarding whether to deploy multi- or single-touch technology in a classroom.

The video footage collected and my analysis thereof in this project open a window to longitudinal studies of the role of touchscreens in classroom practices. Through this window, I have seen how children and teachers appropriate[3] touchscreens for collaborative learning activities in their "natural" classroom settings. Thus, I embarked on a wayfaring journey of exploring, analysing and discussing a way of seeing and making visible children's collaborative and embodied practices around touchscreens, presenting the children's methods for embodied meaning-making. This work has led to a closer familiarity with ethnomethodology (Garfinkel, 1967, 1972, 2002; Heritage, 1984) and embodied interaction analysis (Streeck, Goodwin, & LeBaron, 2011b), which is marked by a distinctive focus on how members inhabit and co-operate situations through a diverse array of semiotic fields (Goodwin, 2000b, 2013).

Remember, children, you have to collaborate!

Given the ethnomethodologic and embodied interaction analytic approaches, the unit of analysis becomes a crucial research question. To introduce the unit of analysis I have come to work with, I share the following situation as an illustration – an appetizer for what I will unfold in the following chapters and in the research papers. One of the first video clips I watched, transcribed and analysed featured two eight-year-old second graders, Peter and Julie, on October 1, 2009. At first, I was surprised to see how the children interacted and were almost in confrontation with each other around the touchscreen. In fact, they were not at all collaborating on accomplishing the assignment given by the teacher. In a way, they were disengaging and deconstructing each other as partners in the activity, especially when working with the assignment. The children were supposed to draw lines between words on the screen, thereby constructing sentences. Julie was in control, and she was positioning Peter in the role of a spectator or "side-participant" (Davidsen & Georgsen, 2010a). Peter was never really given the opportunity to make a contribution in the shared work space, and when he tried to approach the touchscreen or make a suggestion through speech, Julie pushed him aside physically and verbally. Sometimes, Julie told Peter that he could try to make a sentence, but as soon as Peter reached towards the touchscreen, Julie pushed him away and took control again. There was no doubt that they were a pair, according to

[3] Wertsch (1998) defined the concept of appropriation as a "process of making something one's own" (p. 53) and noted that our appropriation of a concept, language, tool, etc. occurs through use. Hence, there is no equation mark between tool and appropriation; instead, appropriation is a situated, cultural, historic and contextual process that is shaped and re-shaped through tool use.

the rule of classroom teaching practice, and, physically, they were sitting next to each other. They were, in fact, also teasing each other a bit; they used a magic drawing pencil to write Julie's name on the screen. They momentarily had good fun, while waiting for her name to magically disappear from the screen. However, Julie was in charge of the assignment work. After five minutes of "finger fighting" and performing "non-school-related matters"[4], the teacher, Anne, raised her voice from the other end of the classroom (see Figure 1, page 6), saying, "you should collaborate about this, right Julie". The teacher was reacting to what was visible and audible to her – namely, the children's body movements and momentarily raised voices, which is the same thing most people would do in a similar situation. This pointed me to the question of what collaboration actually meant in this particular classroom practice and what it may mean at a more general level in classroom settings in the Danish public school system (e.g., the difference between macro- and micro-understandings of collaboration). On a personal level, I became intrigued by the question of how the children oriented themselves and reacted to the announcement of this rather abstract term, "collaboration", because Julie and Peter continued their own method of collaborating after the teacher's intervention. At first, Peter rapidly stretched out his right arm, but soon, Julie was in control again.

To be explicit, it seemed that there was no readymade concept for collaboration to be installed and executed by the children and the teacher. They all were engaged in the process of learning how to collaborate, while they tried to figure out what it meant to be collaborating around touchscreens. Moreover, the situation with Julie and Peter prompted me to think about learning at a more general level, since I found that, in this situation, several learning projects unfolded at the same time. Concurrently, the children were learning how to use the touchscreen, how to collaborate and how to make sentences, while also being engaged in and part of the making and producing of the social interactional order of the classroom. In fact, the children also spent a lot of time building and maintaining their relationship, while they were supposed to be solving assignments. Put differently, learning to collaborate is not just a matter of rule-following (Dreyfus & Dreyfus, 1986) or pooling knowledge together (OECD, 2013), as you might first think when listening to the teacher's call; instead, it requires the building of expertise at many levels, as well as new adaptation each and every time (Firth, 1995). Following Goodwin (2013), the children are in an accumulative transformation zone, building and co-operating in the situation to develop a mutual understanding of collaboration through inhabiting the situation and each other.

[4] I am not arguing that assignment work is the only thing that should take place in collaborative activities. On the contrary, the relationship building activities (e.g., teasing, fooling around, gossiping, making small talk, etc.) seem to be crucial for the process and outcome of the children's collaborative activities around touchscreens.

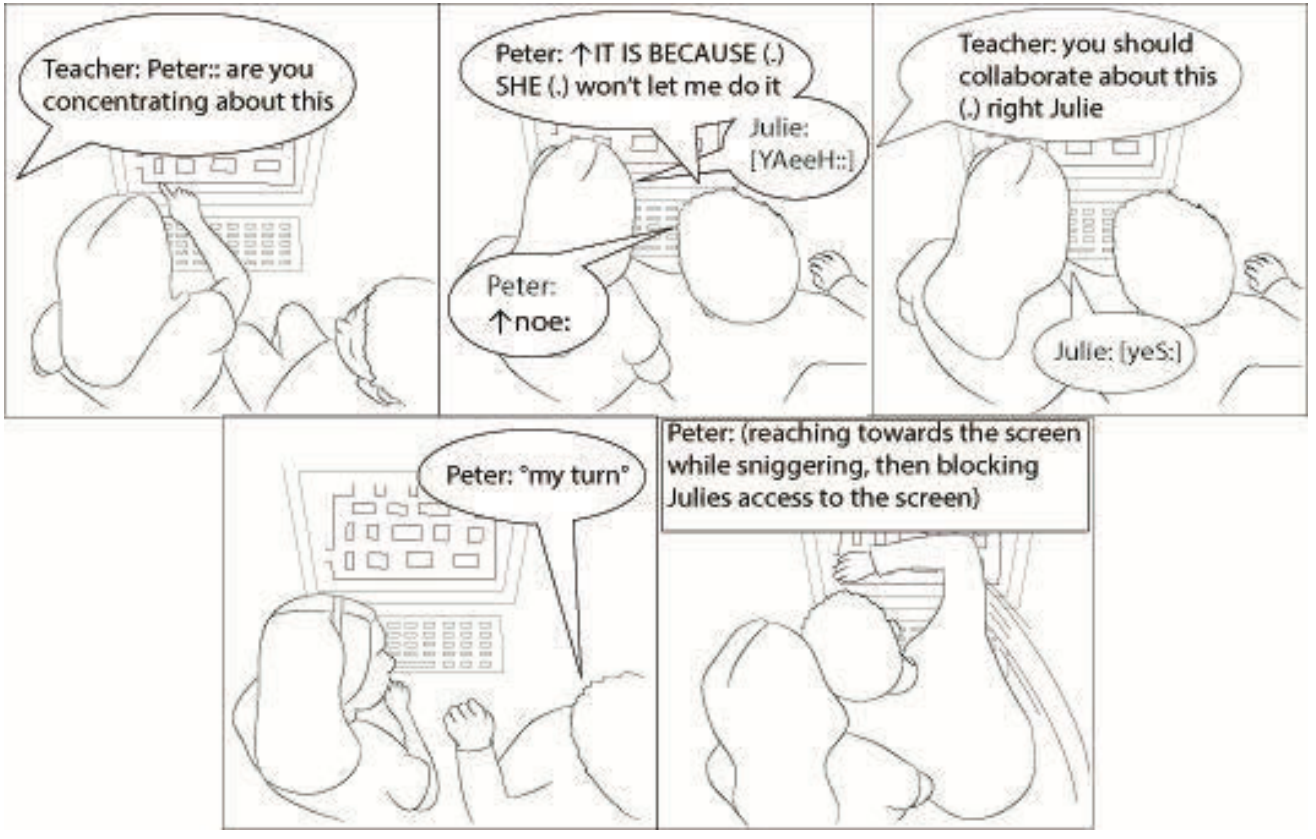

Figure 1- You should collaborate about this (.) right Julie (Version in English – 010714)

Another thing that came to me from watching this particular situation and many others was that the technology alone did not make the children collaborate. There was no inherent *magical* or *technical fix*[5] embedded in the touchscreens, which prompted the children to collaborate on the assignment. As pointed out by Greiffenhagen (2011), computers have been seen as a natural medium for collaboration. This has been argued, for example, in Teasley and Roschelle's (1993) work with the envision machine, in which the technology made two 15-year-old boys work together for 45 minutes constructing a "… rich shared understanding of velocity and acceleration…" (1993, p. 254). This argument can also be found in recent research on multi-user interfaces, like tabletops, which are believed to provide more natural conditions for supporting collaborative learning (see Chapter 5). All of this made me interested in seeing and making visible children's embodied interaction, communication and collaboration as it unfolded between them around the touchscreens (e.g., obtaining a praxeological understanding (Garfinkel, 2002) of the technology and the children's collaborative moment-to-moment actions in situated practices). Throughout the work with the video footage, I have had different hypotheses about the children's development of collaborative skills over the period of the school year. As shown in Paper I (Davidsen & Georgsen, 2010), the children were fighting to control the screen actively, while remaining disengaged from the collaborative activity. For a long time, I hypothesized that this behaviour would gradually disappear, but to my surprise, some of the pairs still behaved like this in some of the final videos, nine months later. For instance, as reported in Paper V (Davidsen & Christiansen, in press), one pair of children were still controlling and constraining each other's access to the screen with their hands, even after nine months of use. This served as a crucial reminder of the situated nature of collaboration and of the many circumstances and conditions influencing the relationship between the children.

From micro-studies to the political macro

The scope of relevance of digging into the puzzlement of embodied collaborative interactions is, however, not limited to producing solid interaction analyses. Such analyses may have the potential to inform educational policy. This became even clearer to me when I learned that, in 2015, PISA[6] will start measuring children's collaborative problem solving skills on an international basis. I do not know the background for the decision, or whether it is a result of the recent focus on collaboration and ICT skills found in policy papers describing and clarifying what children should learn in the 21st century (Ananiadou & Claro, 2009; Dede, 2010;

[5] See, for instance, Säljö (1999) and Selwyn (2011a, 2011b) for a critique of the enthusiastic stance towards the power of ICT to innovate learning and education.

[6] The Program for International Student Assessment is an international organization under The Organisation for Economic Co-operation and Development (OECD).

Voogt & Roblin, 2012). Still, the target group of the PISA test is 15-year-old children (OECD, 2013), who will be tested individually through collaborations with a conversational computer agent. Based on my research, I can only wonder what such an analysis of data, measured in this type of standardised and rather constrained computer-based test, can show about everyday collaboration in the classroom. However, I can say with certainty that it will, by default, exclude the embodied, social and situated aspects of collaborative learning processes.

In PISA's conception, collaboration is a means to support individual growth, learning and development. In other words, collaboration is seen as a tool to support an individual in her/his quest for knowledge in becoming a good world citizen (Popkewitz, 2008). In any case, the underlying assumption regarding the value of collaboration found in PISA is radically different from the one used in the project "Move and Learn" and in this thesis. The same can be said of the research methodologies employed. The difference is most prominent between the coding/counting studies of de-situated performance and behaviour and the descriptive studies of onsite classroom interaction and collaboration (Stahl, 2006; Suthers, 2006). This difference will be apparent in my accounting of related work and in my exploration, analysis and discussion of children's embodied collaborative interactions around touchscreens, which comprise Part 1 of this thesis. To be explicit about my own contribution: I present the outcome as a way of seeing and making visible embodied interactions, which emphasises the children's moment-to-moment, embodied, co-operative (Goodwin, 2013) practices around touchscreens and, in particular, the children's methods for embodied, intersubjective meaning-making. With my lines of wayfaring in mind, I now present the foci, findings and format of this thesis.

Foci, findings and format of this thesis

In brief, this thesis is about exploring, analysing and discussing *ways of seeing* and *making visible* children's moment-to-moment, embodied, collaborative interactions around touchscreens in classroom settings. As mentioned in the previous section, touchscreens are claimed to be a natural fit for supporting collaboration, since multiple users can interact with the technology simultaneously. This assumption is supported by findings from experimental and conditional studies, which have coded and counted what children do around a touchscreen in laboratory settings. In contrast, the research work reported in this thesis builds on data from a longitudinal study of two second grade classes, in which eight- and nine-year-old children collaborated in pairs around touchscreens in the natural setting of their classroom. A research team (Marianne Georgsen and I) carried out ethnographic work for one school year and collected a rich body of qualitative data. Besides participating, photographing, interviewing, small talking and collecting learning materials, we recorded 150 hours of video footage in these technology-rich classroom settings. This is the basis for exploring, analysing and discussing the ways of seeing and

making visible children's moment-to-moment, embodied, collaborative interactions around touchscreens.

The case is, of course, limited, since it was conducted over one year in two classrooms of eight- and nine-year-old second graders. Still, it is an example of an ethnographic study in the sense described by Nardi (1997), who characterised ethnographic studies as holistic endeavours seeking to understand user practices by "going native". According to Nardi, an ethnographic study can identify crucial aspects of actual behaviour, which are significant for understanding both cognitive and cultural development, a position she developed in relation to activity theory (Nardi, 1996). In her comparison of ethnographic traditions, Nardi briefly mentioned a "situated action" perspective, in which the participants' interactions in their everyday practice are analysed from moment-to-moment video segments. This tradition is ethnomethodologically informed, and Stahl (2006, Chapter 12), in developing a moment-to-moment account of a situation of collaboration, argued that his theory of group cognition was established on the basis of the analysis of such a particular moment. Thus, the particulars – the moments of collaboration – analysed in this thesis are used to facilitate and inform the exploration, analysis and discussion of children's embodied collaborative interactions around touchscreens on a more general level. In other words, my contributions – descriptive micro-studies of children's moment-to-moment, embodied collaborative interactions around touchscreen in their classrooms – are used to facilitate a meta-reflective commentary in part 1 of this thesis.

RESEARCH FOCI

My inquiry into the body of data during my PhD project work has been informed by ethnomethodology (Garfinkel, 1972, 2002; Heritage, 1984) and embodied interaction analysis (Streeck et al., 2011b). The micro-studies are represented in Papers I through V in Part 2, which target the question of how children's collaboration around touchscreens unfolds, thus providing examples of children's moment-to-moment engagement and disengagement in collaboration. From the outset of my research journey, I basically asked: "How does children's interaction around touchscreens unfold?" Despite the simplicity of this question, it opened up a diversity of possible ways of studying children's collaboration; moreover, this question did not dictate a specific theory or methodology. At some point in time, I changed the research question to: "How do pairs of children use single-touchscreens for collaboration, and what role does the hand play in establishing and maintaining their collaborative activities?" However, later, I returned to the original question because it, unlike the second one, does not impose any theoretical assumptions onto the analysis. By asking *how*, the question made it possible to follow the policy of relevance from ethnomethodology – namely, that the participants make visible and relevant (Koschmann, Stahl, & Zemel, 2007) those areas that the researcher should look into carefully, and that every situation that the

participants treat as, for instance, collaborative can be taken as an example of collaboration. The introduction (Part 1), in particular, discusses the unit of analysis and its theoretical and methodological underpinnings and explores, through this lens, what can and cannot be said about what happens regarding collaboration in front of and around touchscreens when children are asked to collaborate on a shared assignment. The emergent character of the unit of analysis is visible in the history and the focus of the five papers, during the course of which a crucial change happened: From understanding and treating the hand and body movement of the children as superfluous to their interaction, I learned, through my repeated close examination of the video footage, to see and understand the role of hands and body differently. I came to see the hand and body movements as crucial in their engagement and disengagement in collaborative interaction around the touchscreens. This unit of analysis – the children's moment-to-moment, embodied co-operation in the activity mediated[7] by the touchscreen – is the centre of the meta-reflective commentary found in Part 1. By exploring and presenting a theoretical, methodological and practical way of seeing and by making visible children's embodied collaborative learning, I point to some more general perspectives on children's embodied collaborative interactions around touchscreens. Vygotsky (1978, 1986) argued that pointing gestures made by infants serve the roles of learning (particularly language acquisition) and of establishing intersubjectivity between child and mother. Similarly, this thesis tentatively suggests that body and hand movements are what establish continuity in the act of embodied collaboration around touchscreens. Thus, my primary goal in explicating and discussing a way of seeing and making visible children's collaboration around touchscreens is to point out how free hands (provided by the touchscreen, as opposed to two children sharing a mouse as a pointing device) afford children with a communicative resource, which support their process of engaging and disengaging in collaborative learning.

My methodology and my theoretical focus and interest in children's embodied methods and practices around touchscreens is, first of all, grounded in empirical observations from the project "Move and Learn" (see Chapter 2). Furthermore, as mentioned earlier, the interest in seeing and making visible children's embodied collaborative interactions around touchscreens was invoked and strengthened by the

[7] The concept *mediated activity* is coming from the sociocultural theory of learning and development, e.g. (Rogoff, 2008; Säljö, 2003; Wertsch, 1998). Vygotsky (1978) used the concept of mediated activity to stress that tools (e.g. computers, texts, diagrams, etc.) and signs (e.g. words) mediate our inter- and intra-mental activities. Vygotsky further stated that the relationship between tool and sign are mutually linked, yet separated in the child's development. In this thesis, the concept of mediated activity is used to stress that the tool – the touchscreen – is part of the semiotic resources available to the children's activity. In other words, the particular tool mediates the children's co-operative building of the situation.

findings of experimental laboratory studies and by the political interest in assessing children's collaborative problem solving skills. Related studies on children's collaboration "supported" by touchscreens simply left out the practices of the children's embodied meaning-making by coding and counting children's gestures and speech. Hence, such related studies omitted the qualitative differences contributed by the children's hand movements and speech. Among other things, these related studies resemble usability testing more than they resemble studies on computer-supported collaborative learning. At the political level, collaboration and ICT are believed to be crucial skills for children to master. This might be true, but the conceptualisation of collaboration seems to be based on what can be tested and measured, not how children organise and develop order in collaborative activities. As a counterexample, this thesis, through micro-studies, describes how children co-operatively inhabit a collaborative situation (Goodwin, 2013) and make use of the material resources in their configuration of the context (Goodwin, 2000a). Thus, the thesis subscribes and contributes to a growing body of studies of embodied intersubjectivity, or what Streeck (2009, p. 206) referred to as corporeal intersubjectivity. Taken together, the thesis primarily orients and contributes to the field of computer-supported collaborative learning (CSCL) and, more specifically, a descriptive tradition of CSCL, in which learning is viewed as a social, material, cultural, historical and interactional matter between participants using a technology, tool, artefact or inscription.

SUMMARY OF FINDINGS

Each of the five papers included in Part 2 of the dissertation contributes to the understanding of how children's embodied collaborative interactions unfold around touchscreens. In addition, the papers show a progression in my understanding of collaboration and of how collaboration can be analysed. The papers explore subcategories of the overall research question, such as: the learning potential in collaborative work, the challenges of establishing collaborative learning dialogues between children, the benefits of single-touchscreens for intersubjective meaning-making, how researchers and teachers can learn together using multimodal video analysis, how researchers can obtain children's perspectives and what role the hand plays in children's collaborative activities around touchscreens. In other words, the different papers each contribute to answering the question regarding how children's collaboration around touchscreens unfolds in classroom settings. To summarize, the papers contribute three main findings (which my research wayfaring has allowed me to find regarding the "*how* question"), which are the following:

1. Children use their hands to engage and disengage in the collaborative activities around touchscreens and to build corporal and embodied intersubjective meaning-making.

2. Children contingently monitor, co-operate and interpret the situation, actions and semiotic resources together in front of the touchscreens and build and treat the situation as collaborative.
3. Children competently[8] co-operate and inhabit the moment-to-moment situations, building complex and accumulative methods of engaging and disengaging in collaboration around touchscreens.

The merit of these insights can, of course, only be estimated by contextualizing them within a relevant research tradition – in this case, the traditions of qualitative research and of CSCL research on the deployment of digital technologies in classroom settings. Accordingly, I examine both here, which allows me to outline my research contribution methodologically, as well as with regard to children's embodied collaborative learning with and around touchscreens. These contributions can be summarised as follows:

- Embodied and multimodal video analysis of children's collaboration around touchscreens offers the children's perspective, pertaining to their worlds and their means of interaction. This perspective allows researchers and teachers to understand how children actually engage and disengage themselves in collaboration around touchscreens. By exploring and developing different techniques for representing children's embodied collaboration around touchscreens (see Chapter 4), the thesis also contributes a portfolio of representational techniques of children's interaction around touchscreens.
- In practice, collaboration is not a ready-made and predefined concept, and touchscreens are, by no means, a natural tool for supporting collaboration. On the contrary, collaboration is developed, recognized, nurtured, and established over time by the children through contingently performed embodied actions.
- Embodied and multimodal micro-analysis can reveal to teachers the unnoticed and subtle details of children's collaboration, which have proven useful to teachers' emergent understanding of how pairs engage and disengage in collaboration and in the teacher's design of learning materials for collaboration.

Extracting the essences of the different papers points to the aim and foci of Part 1, which centres on what the papers communicate in a larger perspective: a reflection and commentary on the examples of eight- and nine-year-old children's hand and

[8] In this context, "competently" refers to the ethnomethodological stance towards member practices. Ethnomethodology builds on the powerful assumption that members are competent in whatever they are doing and that the analysis exists to understand this competency. See Chapter 3 for more information about ethnomethodology.

body movements around touchscreens in collaborative learning activities. By explicating a theoretical, methodological and practical background, I present a way of seeing and making visible children's moment-to-moment embodied collaboration in Part 1. Thus, I engage in a discussion and commentary of the qualitative differences between various methodological and theoretical positions within the community of CSCL. In other words, I seek to lift the findings from the papers into a meta-level reflective commentary of my academic wayfaring.

FORMAT OF THE THESIS

The format of the dissertation is a "wrapping" consisting of two separate parts: Part 1, which comprises seven chapters, and Part 2, which is a collection of five research papers. Part 1, is a meta-reflective commentary on my research process and offers a story of my process of coming to see and make visible children's embodied collaborative learning at a methodologically, theoretically and practically level. In Part 1, the first chapter briefly presents my inhabitation of the project "Move and Learn"; moreover, it outlines the foci, findings and format of the thesis. Chapter 2 describes the case and the research process, including my initial participation in the project "Move and Learn". Chapter 3 presents my research background as an entanglement of CSCL, ethnomethodology and embodied interaction analysis. In Chapter 4, I reflect on video analysis as a craft (e.g., learning and appropriating the customs, the tricks of the trade and the methods of transcription, representation and analysis used when working with video footage). In Chapter 5, I present the findings from related studies on collaboration around touchscreens. In Chapter 6, I present a summary and a reflection on my findings in the five papers (e.g., what micro-studies of children's embodied and co-operative interaction offer in terms of understanding collaborative learning around touchscreens in a larger perspective). The final chapter, Chapter 7, summarises and concludes Part 1; moreover, it outlines future research topics and the limitations of my research. Part 2 (a separate publication) consists of the five research papers written in connection to my PhD, which are enclosed in the following order:

I) Davidsen, J., & Georgsen, M. (2010). ICT as a tool for collaboration in the classroom – Challenges and lessons learned. *Designs for Learning*, 3(1-2), 54–69.

II) Davidsen, J., & Christiansen, E. T. (2013). The benefits of single-touchscreens in intersubjective meaning making. In N. Rummel, M. Kapur, M. Nathan, & S. Puntambekar (Eds.), *To see the world and a grain of sand: learning across levels of space, time, and scale* (Vol. 2, pp. 10-14). International Society of the Learning Sciences (ISLS).

III) Davidsen, J., & Vanderlinde, R. (2014). Exploring what touch-screens offer from the perspectives of children: Methodological challenges. In G. B. Gudmundsdottir & K. B. Vasbø (Eds.), *Methodological challenges when exploring digital learning spaces in education* (pp. 115–132). Rotterdam/Boston/Taipei: Sense Publishers.

IV) Davidsen, J., & Vanderlinde, R. (2014). Researchers and teachers learning together and from each other using video-based multimodal analysis. *British Journal of Educational Technology*, 45(3), 451–460. doi:10.1111/bjet.12141

V) Davidsen, J., & Christiansen, E. T. (in press). Mind the hand: A study on children's embodied and multimodal collaborative learning around touchscreens. *Designs for Learning*.

The research papers, or individual studies, illustrate the process of coming to an understanding of how children engage and disengage in collaborative activities in front of and around touchscreens. The wrapping builds its argumentation on the papers' work, which shows the development in my understanding of children's collaborative activities around touchscreens. Put differently, while the papers have been published throughout the course of my wayfaring (Ingold, 2007, 2011) and each focus on and address different questions, Part 1 of the wrapping fulfils another purpose: namely, summarising and looking forward by engaging in a theoretical, methodological and practical presentation and reflection on ways of seeing and making visible children's embodied collaborative interactions around touchscreens.

CHAPTER 2

Case - Project “Move and Learn”[9]

In July 2009, Western State School invested in sixteen 23-inch single-touchscreens as a part of the project “Move and Learn”. These touchscreens were placed in two different second grade classrooms, and the eight- and nine-year-old children were told by their teachers to collaborate in pairs in front of the touchscreens. Besides the investment in the touchscreens, the school provided each child with a headset and a pen drive and each teacher with a laptop and an external hard drive. Over the summer break, each of the teachers had borrowed one of the touchscreens to become familiar with the technology and the Smart Notebook™ 10 software. This software package was installed on all of the single-touchscreens and on the interactive whiteboard in the classrooms.

Figure 2 - Boy and girl colouring figures (September 16, 2009)[10]

[9] Parts of this presentation has been presented in (Davidsen & Georgsen, 2010a, 2010b; Davidsen, 2010)

[10] Figures 2, 3, 5, 6 and 8 show situations from the two classrooms, and mainly serve the purpose of showing different pairs of children engaged and disengaged in collaborative activities around touchscreens.

Together with Marianne Georgsen, I followed the appropriation of this technology throughout one school year, from the first day of use to the final day of school. The two of us were present in the classrooms for 21 full school days, and during our engagement at the school, we collected a variety of ethnographic field data, including more than 150 hours of video footage from the two classrooms. Below, the project "Move and Learn" is introduced, followed by a description of the research project and the collected data.

PROJECT MOVE AND LEARN

The general focus of the project "Move and Learn", financed by the funding agency "Skolen for Fremtiden", was on ways to support collaboration, interaction and experimental forms of learning around touchscreens in classroom settings (Davidsen & Georgsen, 2010a). In other words, the project focused on how children could learn together in pairs, using the touchscreens as a mediating resource. Project "Move and Learn" specifically targeted ways of combining movement and learning within the boundaries of the classroom, based on the assumption that this would make children want to learn together with others and to explore new ways of learning (Davidsen & Georgsen, 2010b). In particular, the project was designed to augment and cultivate multiple ways of learning through the use of "… auditory, visual, tactile and kinaesthetic approaches …" (Davidsen & Georgsen, 2010a, p. 56).

Figure 3 – Three girls being engage/disengage in collaborating (September 16, 2009)

The most important goal, perhaps, was to zoom in on the development of children’s collaborative skills and of learner-centred teaching methods. The configuration of the classrooms with the new technology was instigated by the school and involved, in particular, a collaborative process between the teachers and the ICT advisor in order to create more flexible teaching and learning spaces. The physical arrangement of the classrooms was designed with individual workspaces for each child, facing the walls of the room. This allowed each child a fairly sheltered workspace and left the centre of the room available for a wide range of activities (see Figure 4 below).

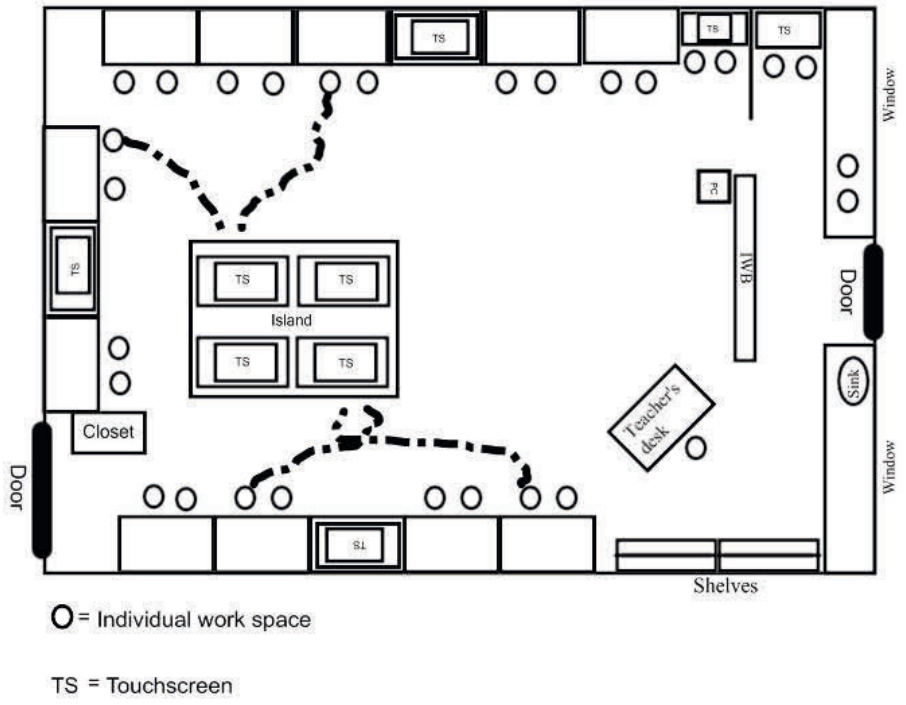

Figure 4 - Classroom layout with children’s work spaces along the walls and in the centre of the room (dotted lines indicate children’s movement from their individual workspaces to the touchscreens)

At one end of the room, the teacher had a desk, which was situated next to an interactive whiteboard. The eight touchscreens were placed along the walls and in a small island at the centre of the room. When the children coupled together in front of the touchscreens, they moved to new places, both in order to get to where the touchscreens were and in order to team up with their partners for the collaborative assignments. The touchscreens were introduced into all subject matters, although the actual frequency and extent of use varied from teacher to teacher, as well as over time for each individual teacher. Most of the time, the teachers designed their

own digital learning materials for the children's collaboration around the touchscreens. However, in some cases, the touchscreens were used as "regular" computers (e.g., to play educational games from Internet resources or to type text into word processing software using a keyboard). During the process of incorporating the touchscreens into everyday use, several pedagogical and qualifications-related themes emerged for both teachers and children. The teachers sought to let the children work together in pairs (and sometimes in triads) most of the time to strengthen collaboration and dialogue. The general pedagogical approach was to enable and support the children to work and learn in different ways with different partners. Most importantly, though, the project built on the hypothesis that the collaborative skills of the children would be strengthened by using touchscreens and that the dialogue between children was expected to add to both the experience and the outcome of learning together.

Figure 5 - Claire guiding a pair in classroom X (September 16, 2009)

As mentioned, the touchscreens were integrated into two separate classrooms – X (21 children) and Y (20 children) – which were positioned opposite to one another in the same building. Three teachers were affiliated with the two classes: Anne taught in both X (Danish) and Y (math), while Ben taught only in Y (Danish) and Claire[11] taught only in X (math). Anne was the primary teacher in X, and Ben held

[11] Claire also taught in another second grade class, which did not participate in the project "Move and Learn".

the same role in Y. Anne’s and Ben’s ways of organising and structuring the classrooms differed in several respects. A key difference was that Anne decided which children should work together; she changed the combinations at regular time intervals or when something crucial or unexpected happened. Ben, on other hand, let the children themselves figure out the combinations, and he asked the children whom they wanted to work with for each touchscreen activity. Sometimes, Ben had to intervene and make new pairs during the day or to remind a pair about its difficulties in collaborating the day before.

Figure 6 - Two girls reaching towards a touchscreen, making a fairy tale together (April 12, 2010)

Other factors and conditions influenced the daily classroom routines, such as children being absent, conflicts from breaks or excursions outside school, etc. Taken together, several circumstances and conditions influenced classroom interaction, collaboration, teaching and learning in the studied environment.

The ICT advisor at the school played an important role in the project. First, he was the primary pedagogical sparring partner for the teachers; second, he managed day-to-day maintenance and configuration of the touchscreens; and third, he served as the research team’s gatekeeper to the school, the classrooms and the worlds of the teachers and children.

In summary, the children and the teachers experimented with the affordances of the touchscreens for dialogue, collaboration and learning throughout the project period

as a part of their everyday classroom practices. It is important to note that the use of the term "collaboration" in the project "Move and Learn" did not connote or subscribe to any established theories of cooperative learning, peer learning or collaborative learning (O'Donnell & Hmelo-Silver, 2013) (e.g., testing a theory in practice or "documenting the effective use of collaborative learning techniques" (ibid, p. 5)). This difference provided a unique opportunity for an ethnographic approach (Nardi, 1997) and, in particular, for the study of children's embodied interactions in collaborative activities around touchscreens and of how teachers designed for and guided children in their classroom over the course of a school year.

RESEARCH IN PROJECT "MOVE AND LEARN"

The methodological design informing the research project was rooted in dialogue design (Nielsen, Dirckinck-Holmfeld, & Danielsen, 2003) and action research (Andriessen, 2007; Coghlan, 2005), which, to some extent, is related to design-based research (Barab & Squire, 2004; The design-based research collective, 2003), with regard to the interaction between practice and research. However, it is important to note that the researchers did not design experiments or interventions based on theoretical perspectives or hypotheses about collaborative learning and teaching, which stands in contrast with the merits of, for instance, design-based research, in which (theoretical) designs are tested, evaluated and modified in practice. In other words, the researchers (Marianne Georgsen and I) sought to follow the process of integrating the touchscreens into the classrooms with a minimal level of theoretical or researcher-informed interference. In particular, we did not seek to evaluate the teachers' or children's actions in the classrooms based on theory or pre-established criteria of good and bad teaching.

The year-long engagement with the project provided an opportunity for a longitudinal collection of data. This collection encompassed interviews with teachers, parents and children; teacher-designed learning materials and children's multimodal productions; field notes; blog posts from participating teachers; timeline logs in a shared Wiki; photos from the classrooms; and, most importantly, more than 150 hours of video, which hold a prominent role throughout my thesis work. In the following sections, I account for my ethnographic engagement in the classrooms and for the process of collecting the video footage. Later, in Chapters 3 and 4, the methodological considerations of analysing the video footage will be introduced and discussed. It should be noted that Marianne Georgsen and I were, at first, interested in the process of integrating the technology into the classrooms and in the pedagogical development in practice, but that I gradually turned my research interest towards the children's moment-to-moment, embodied collaborative interactions.

Participation in practice

My ethnographic engagement and participation in the classroom practices’ served as way of becoming a participant, accepted by teachers, children, parents and school administration (i.e., the natives). Besides allowing me to become someone known by the natives, the experience of being there, sitting on the exact same stools as the children, listing to the teachers’ instructions and meeting the parents for interviews provided a more holistic understanding of the life of the project “Move and Learn”. Before engaging in the classroom practices, each parent with a child in one of the two classes signed an informed consent form, allowing their child to be recorded on video. With this contract, the parents also agreed that the video footage could be used for papers, conference presentations and teaching. The school handled this process and kept the contract forms. To protect the identity of those involved, the researchers have anonymised the names of the children, teachers and school. Each of the three teachers also signed an informed consent contract allowing the video footage and collected material to be used for research purposes.

Figure 7 - Video feedback session in classroom X with teachers and an ICT advisor (from the left: Anne, Clair, Ben, the ICT advisor, Marianne Georgsen and Jacob Davidsen)

As reported in Davidsen and Vanderlinde (2014b), parts of the dialogue between the teachers and researchers (Marianne Georgsen and I) took place during video feedback sessions (see Figure 7), which aimed to facilitate mutual learning on the basis of the video footage from the classrooms. In several aspects, this is similar to the ethnomethodological research approach outlined by Lindwall and Lymer (2005), who contested that educational researchers interested in professional practice should focus on the "immanent pedagogies"(p., 393-394), rather than making and claiming generalisations. Watching the subtle details of the children's interactions unfold allowed teachers and researchers to stay closer to the actual events, fully engaged in comprehending what happened on a particular video extract, rather than engaging in post-reflective interviews and discussions about "memorised" episodes of interaction (Jordan & Henderson, 1995). Moreover, and of equal importance, the teachers' way of evaluating the children's collaborative activities was analysed by the teachers themselves. In other words, the teachers were given the opportunity to see, as spectators, their classroom practices and how pairs of children engaged and disengaged in collaboration from a detailed perspective, which, according to Hester and Francis (2000), may the best way to reflect on and improve practice.

Figure 8 - Two boys working together in classroom Y (November 18, 2009)

Entering and researching children's practices can be approached from different methodological and theoretical perspectives. According to Christensen and James (2008), researchers have traditionally positioned children as objects (i.e., researching *on* children); however, they suggested that researchers should instead

treat children as subjects (i.e., researching *with* children). In a similar fashion, Cook-Cumperz and Corsaro (1986) argued that researchers should study children's means of interaction (i.e., their worlds), rather than seeing their interaction through adult eyes (c.f. Linell, 2014). Woodhead and Faulkner (2008) argued that generations of developmental researchers have turned children into de-personalised numbers for statistical comparison and generalisation.

> Their subject – the child – is thereby transformed into a de-personalized object of systematic enquiry, their individuality evaporated into a set of measurable independent and dependent variables, and then condensed into general laws of behaviour.
>
> (Woodhead & Faulkner, 2008, p. 14)

Thus, seeing the video footage of the children interacting around the touchscreens from the children's perspective was crucial for our research in the project "Move and Learn". This was accomplished by, among other things, treating the children as competent practitioners (see Chapter 3) in their practice, a research perspective informed by ethnomethodology.

Collecting video footage

In order to capture the children's interaction in front of the touchscreens, we had to carefully consider the camera position. The position of the camera focuses on and highlights certain particularities of the interaction, while omitting others. In the two classrooms, the cameras were positioned above the children (see Figure 9) in order to capture their interaction around the touchscreen, and small external microphones were glued to the screen in order to better capture their verbal interactions. The small web cameras were used to minimise the level of presence and disturbance in the classrooms; however, the children oriented themselves towards the cameras throughout the project, especially in the first couple of months, sometimes making funny faces or asking who was watching them. Still, on an overall basis, the cameras did not seem to change the children's behaviour. The cameras above the workspaces captured the children's movements in front of the screen and their use of other material resources, such as leaflets, drawings, hand-outs, etc. In other words, the position of the camera framed our perspective of the children's collaboration. According to Erickson (2006), fixed cameras offer, to some extent, a phenomenologically neutral account of interaction, since the researcher does not move, zoom or focus the camera on particularities of interest during the recordings. Moreover, Erickson also argued that the position of the camera in a classroom signals both the interest of the researcher and the researchers' understanding of what classroom interaction is. Thus, the positioning of the camera above the children sitting in front of the touchscreens also served as an indication to the teachers that the research team primarily sought to explore and understand the

children's ways of interacting and learning together around the touchscreens. Regrettably, the researchers did not make use of screen-capturing software, a choice that has sometimes made it difficult to elicit the interaction with the touchscreen from the video footage. However, having the ability to load the digital learning materials afterwards has made it easier to understand some of the special movements and gestures made by the children. Another important aspect that is not possible to analyse with this camera angle is that of the children's gaze orientation. However, it is still possible to see how the children engaged and disengaged in the collaborative activities through language and body movements. In addition, we decided to focus exclusively on the children, and not on the classroom or on the teacher's instruction at the interactive whiteboard. After a while, we decided to place an extra camera in classroom Y to capture the movement of the teacher from pair to pair and to see how the children oriented themselves in the room and engaged with other pairs.

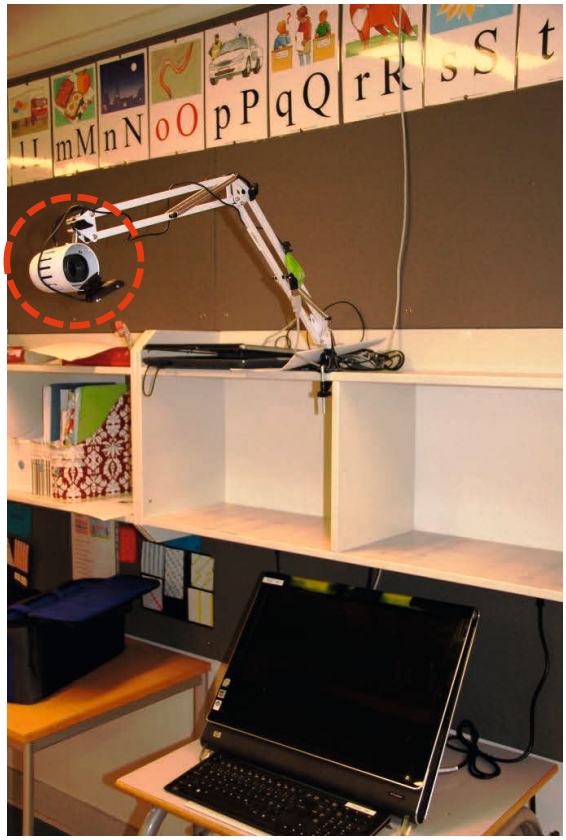

Figure 9 - Camera position above touchscreen (Classroom X)

In the context of the project "Move and Learn", the teachers were in charge of starting and stopping the video cameras on a daily basis. Put simply, it was not feasible or possible for the research team to go to the school every day. Thus, the project required a recording system that was simple to operate and small in size, since the teachers were in charge of making the recordings. Moreover, it required the researchers to obtain additional information about what happened in the classrooms on the days that we were not present. To facilitate an easy reporting system for what happened in the classrooms those days, we first positioned schemas next to the cameras for the teachers to note what happened in each video; however, this was not manageable for the teachers as one of their many tasks in the classrooms. Instead, a shared online Wiki was established, and here, the teachers made more general notes about leave, special themes, substitute teachers, etc. This served to place the events on each video recording within a larger picture of classroom activities. It is important to notice that the studies of the children's moment-to-moment, embodied collaborative interactions are embedded within the overall contexts of classroom, school and society. This is to say that, taking an ethnomethodological position, the micro-level analyses of the children's embodied collaborative interactions are embedded in and part of several macro-structures, but that I strictly investigate how children's moment-to-moment embodied collaborations around touchscreens unfold in the classroom practice.

SUMMARY OF CASE

In summary, the yearlong engagement in the project "Move and Learn" and the resultant collection of data serve as the empirical basis for my thesis work. The process of collecting the data was formed and shaped by my interest in understanding children's collaboration around touchscreens, and the research design was by no means fixed; on the contrary, it was influenced and accommodated through inhabitation of the practice. As such, my wayfaring and habitation of the classroom practice and the ethnographic data over time served as critical guidelines in researching the project "Move and Learn". I have explored examples of the children's naturally occurring, moment-to-moment, embodied collaborative interactions around the touchscreens in the papers (see Chapter 6) based on this case. Part 1 of this thesis adds a meta-reflective commentary to the process of coming to see and make visible children's embodied, moment-to-moment interactions. I will now outline the theoretical and methodological entanglements on which I build and align my work to.

CHAPTER 3

Theoretical and methodological entanglements

Having presented the aim and foci of my thesis, as well as the case and initial research upon which I build my work, I will now introduce my theoretical and methodological background, which is an entanglement of computer-supported collaborative learning, ethnomethodology and embodied interaction analysis. The complexity and history of these fields have been explored along my wayfaring of coming to see and make visible children's embodied collaborative interactions using video footage. Bear in mind that the aim of the thesis was to understand how children's interactions around touchscreens unfold. Hence, I present a research background for exploring, analysing and discussing how embodied collaborative interactions unfold and can be understood. While this chapter introduces my theoretical and methodological background, the next chapter will present my wayfaring into the craft of embodied video interaction analysis, with special emphasis on the role of transcriptions, re-presentations and supporting software tools.

The chapter is divided into three sections; first I briefly present understandings of CSCL and elaborate on some of the distinct characteristics of CSCL; second, I outline Garfinkel's study policies, which have informed my work in finding a way of seeing and making visible moment-to-moment, embodied interactions using video analysis; and third, I zoom in on embodied and multimodal interaction and, in particular, hand movements as resources for meaning-making in embodied interaction. In total, this chapter will synthesise understandings from CSCL, ethnomethodology and embodied interaction analysis, which have supported me in seeing and making visible children's moment-to-moment, embodied interactions around touchscreens. I view the methodological and theoretical entanglements as mutually elaborating in seeing and making visible children's embodied participation and interactions around touchscreens.

UNDERSTANDINGS OF/IN CSCL

With the introduction of computers into education, work and everyday life, several research fields dealing with computers in these contexts of use have emerged. Two research fields, which often overlap in theory and methodology but are, nevertheless, different in aims, domains and scopes, have been active in obtaining understandings of computers in these contexts: namely computer-supported cooperative work and computer-supported collaborative learning. Recently,

researchers from the two fields have connected more (e.g., through CSCL@work[12], which is an attempt to align, convey and synthesise the learning and knowledge from both fields). For now, I primarily orient my research towards the field of CSCL, which has provided the basis for my theoretical and methodological discussions on understandings of collaborative learning around and through computers. CSCL is a multi- and cross-disciplinary research field, which draws on a diverse set of theoretical and methodological perspectives; however, the common denominator is an interest in understanding and/or designing for collaborative learning around and through computers. I draw upon CSCL research in general, but my thesis contribution is located in what could be termed CSCL@school.

Collaboration and/or cooperation

A recurring debate in CSCL concerns the difference between cooperation and collaboration. Dillenbourg (1999), in a much-cited publication, defined the difference between cooperation and collaboration as the difference between *splitting* the work into subtasks and doing the learning *together*, respectively. Building on theories and methods from social psychology and machine learning, the authors of the chapters in Collaborative learning – Cognitive and computational approaches established a body of theoretical, methodological and empirical perspectives in CSCL. For example, Dillenbourg claimed that collaborative learning takes place as a reciprocal relationship between *situation*, *interactions*, *processes* and *effects* (1999). Thus, Dillenbourg also established a model for designing and analysing collaborative learning environments. What is absent in Dillenbourg's understanding and model from 1999 is an explicit focus on technology (e.g., tools, inscriptions, artefacts, etc.) in collaborative learning environments. Since then, CSCL researchers have had an explicit focus on particular technologies (e.g. rocket simulation software, wikis, blogs, tabletops, MMORPG's[13], etc.) and their affordances and constraints with regard to supporting collaborative learning. Stahl (in press) suggested that the application, design and analysis of novel technologies in learning contexts could serve as a basis for new theoretical advancements in learning on a more general level.

Like Dillenbourg, Littleton and Häkkinen (1999) also asked the rhetorical question "What is collaborative learning?" They listed some of the various conceptualisations of collaborative learning, including "peer collaboration", "coordinated learning" and "collective learning", each of which seek to specify and encapsulate what it means to be learning together[14]. One (in my opinion)

[12] http://www.csclatwork.org/

[13] Massively Multiplayer Online Role Playing Games.

[14] For a recent overview of different conceptualisations of collaborative learning, see O'Donnell and Hmelo-Silver (2013).

challenging assumption found in the work of Littleton and Häkkinen is the simplistic analysis of "common people's" understanding of collaboration.

> To a lay-person, the term "collaboration" is unproblematic – collaboration simply refers to the fact that people are working together on a task.
>
> (Littleton & Häkkinen, 1999, p. 20)

If it were that simple for people to collaborate, then research on how collaboration unfolds in practice would not be necessary to conduct. In particular, and I remind the reader about the teacher's statement "you should collaborate about this, right Julie" on page 6, I find that Littleton and Häkkinen's way of writing about "common people" implies that collaborative learning is a purely theoretical problem – that is, that the term is not a problem of concern for the actors performing and conducting collaboration in practice[15]. Hence, I have been working with theoretical and methodological perspectives that scrutinise laypersons' ways of organising and ordering collaborative learning around and through computers.

CSCL, as a research field, is composed by many theoretical and methodological perspectives, and I have only touched upon a few of the general defining understandings and tensions here. Now, I turn to understandings of what it means to be learning, as well as some understandings of learning emerging from CSCL research.

Learning as participation and interactions – in/outside of CSCL

Researchers dealing with the question "What is learning?" have tried to encapsulate and explicate the processes of learning. According to Sfard (1998), two basic metaphors for learning are in play: *acquisition* and *participation*. *Learning as acquisition* is viewed as an individualistic process, in which knowledge and learning are things that can be transferred or possessed by individuals: cognitive containers that can incorporate new entities into existing structures. In contrast, *learning as participation* builds on ideas of becoming a member in a community: that is, learning the customs, routines and specialised actions of a community. In conclusion, Sfard proposed to integrate, not separate, the two metaphors, since they are, in some ways, complimentary. In response to Sfards' two basic metaphors of learning, Koschmann (2001) proposed a dialogical metaphor informed by Dewey's transactional inquiry, and Paavola and Hakkarainen (2005) offered a knowledge

[15] In CSCL, research on how to organise, structure and arrange collaborative learning has been promoted under the heading of "scripting". Collaborative learning scripts guide and promote collaborative behaviour and, supposedly, make collaborative learning more effective. See Dillenbourg (2002) for an introduction and some critical remarks.

creation metaphor based on reviews of three models of knowledge-innovative communities. Both the dialogical and the knowledge creation metaphors explicitly seek to bridge the gap between the acquisition and participation metaphors of learning. Nevertheless, the positions and discussions about *what learning is* – individual and/or collective, cognitive and/or social, acquisition and/or participation-based, dialoguing and/or knowledge creating – is still present. This, perhaps, tells us something about the force of these opposing views in discussing what learning is.

Before Sfard introduced her metaphors for learning, Bamberger (1991), based on her work in the laboratory for making things, delineated two similar, though unique, positions: intelligence-as-information and intelligence-in-action[16]. According to Bamberger, intelligence-as-information is the most prominent in education, whereas intelligence-in-action is undervalued. With established curricula and assessment procedures, intelligence-as-information has a strong tradition in Western society. In contrast, intelligence-as-action has a less-established curriculum and no formal assessment procedures; it is all about doing and, most importantly, changes in doing. Intelligence-in-action and learning-as-participation are central *ways of thinking* in my emergent understanding of collaborative learning, as these perspectives enunciates collaborative learning as a social, cultural, historical, interactionally situated and tool mediated activity.

In the CSCL literature, Teasley and Roschelle's (1993) study of two 15-year-old boys working around a computer shows the tensions between acquisition/intelligence-as-information and participation/intelligence-in-action. Teasley and Roschelle contested that collaboration is a "… coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" (1993, p. 235). The focus on sharing a conception and maintaining a shared understanding in collaboration captured in this definition is problematic, since it connotes that individuals can share their understandings of a given phenomenon – in other words, that their understandings and cognition overlap. In addition, the focus on constructing and maintaining a shared understanding of a problem suggests that the participants see, understand, conceptualise and approach the problem in the same way, an assumption that can be found in much research on collaboration. According to Stahl (in press), who outlined his personal journey into CSCL, Roschelle (1992) was forced to change the conceptual wording of his original paper by the editor of the Journal of the Learning Sciences into more cognitive oriented terms. In contrast, Roschelle and Teasley (1995), in a later publication about the same research data, used statements

[16] Wilson (1999) used Bamberger's (1991) two positions in his neurologic account of human development – both on a phylogenetic and an ontogenetic level –, and stressed that there is a close relationship between what we do with our hands and our cognitive development.

like "… actions and gestures can likewise serve as presentations of new ideas …" (p. 79) and clearly argued that (shared) knowledge is constructed and negotiated using language, gestures and actions. Thus, there seem to be inherited tensions between the metaphors of learning in CSCL, which might constrain new advancements in theory, methodology and practice. Next, I will expand on learning-as-participation and intelligence-in-action in a CSCL context.

Intersubjective learning and group cognition

Within the community of CSCL, Stahl, Koschmann and Suthers, to name a few, have outlined and expanded on learning-as-participation and interaction. Individually and collectively, Stahl, Koschmann and Suthers build their theoretical and methodological perspectives on the moment-to-moment analysis of collaboration. For example, Suthers (2006) distinguished between an individual epistemology, a knowledge-communication epistemology and an intersubjective epistemology and argued that CSCL should, in essence, examine a technology's affordances for intersubjective meaning-making through hybrid studies[17]. According to Suthers, intersubjective learning, in its most radical form, consists of the participants' interactions (intelligence-in-action); thus, learning is not a cognitive work, taking place outside the accomplishment of the interactions. This is, perhaps, best exemplified in Suthers' interpretation and application of Wenger's (1999) concept of "reification":

> An interpretation takes a reification as having a given significance for ongoing participation, thus, in effect, forming a new reification. Interpretation functions as much on moment-to-moment ephemeral reifications such as thoughts, utterances, facial expressions, and gestures as on persistent inscriptions and artifacts.
>
> (Suthers, 2006, p. 321)

Recognising both ephemeral and persistent interpretations and reifications as essential parts of a collaborative learning situation challenges how learning has been conceived and prescribed within CSCL and within learning science in general. Put differently, if learning is understood as participation and action, then learning must be located in the subtleties of interactions, interpretations and reifications. This contrasts with the idea that the outcomes (products) of tests, exams, etc. represent the tokens of learning[18] (intelligence-as-information). Another important

[17] Suthers is arguing that CSCL's traditional research approaches (i.e., experimental, descriptive and iterative design studies) should convene in a shared focus on technologies' affordances for intersubjective meaning-making.

[18] The distinction between process and product is also present in discussions on how to perform assessments of collaborative learning.

point about intersubjective learning is that the learning agent comprises the pair, group or collective, which contrasts with individual (cognitive) theories of learning, in which only single agents learn in cognitive process of accommodation and assimilation.

Stahl (2006) offered a similar position with his theory of group cognition, which seeks to overcome the focus on the individual in cognition and learning by drawing on the work of Lave, Hutchins and Vygotsky (to name a few of his inspirational sources). He argued that "*meaning is created across the utterances of different people*" (Stahl, 2006, p. 6, italics in original). To escape the focus on the cognitive individual when using the term "learning", Stahl (2006, Chapter 15) suggested using "building knowledge"[19] to emphasise that groups often learn ways of doing things in certain practices by interpreting and negotiating a problem formulation or solution together using language. This is very similar to a point presented by Sahlström in a second language-learning context, which also discussed the acquisition and participation metaphors. Sahlström, in developing a conversation analysis of two girls evolving practices of learning how to count to ten, showed how the girls changed their ways of doing in different settings. Thus, he argued that, in order to understand learning-as-participation, researchers should focus on "changes in doing, rather than as a doing in itself." (Sahlström, 2011, p. 45); that is, learning *is* changes in ways of doing over time and across settings using different material resources.

Underlying the development of a theoretical concept of intersubjective learning and group cognition is Koschmann's characterisation of CSCL as "a field of study centrally concerned with meaning and the practices of meaning making in the context of joint activity, and the ways in which these practices are mediated through designed artifacts" (Koschmann, 2002, p. 20). Koschmann's programmatic definition of CSCL opened a window to conceptualise and understand collaboration differently, which is captured in the theoretical concepts of intersubjective learning and group cognition. However, group cognition and intersubjective learning neglect the body in collaborative learning, while maintaining a strong focus on the role of language in collaboration interactions. I will briefly touch upon CSCL research on the body and, in the second section of this chapter, outline a position that emphasises language, the body and material in collaborative activities.

[19] This perspective on learning shares similarities with the metaphor for learning outlined by Paavola and Hakkarainen (2005).

CSCL: Embodiment, body and gestures

The purpose of this section is to briefly present how CSCL, including human-computer interaction (HCI)[20], has worked with body, gestures and embodiment in collaborative learning contexts. This will serve as a basis for engaging in theoretical and methodological exploration in the next sections, where I will outline a way of seeing and making visible children's embodied interaction around touchscreens.

The role of the body in establishing social practices (Stahl & Hesse, 2006) has widely been acknowledged in the CSCL community; however, there seem to be no coherent or consistent theoretical or methodological perspectives on the body or the concept of embodiment in CSCL. When referring to body, gestures and embodiment, CSCL researchers adhere primarily to two sources: 1) an ethnomethodological perspective (Garfinkel, 1967), as found in the work of Goodwin (2000) and, more recently, Streeck, Goodwin and LeBaron (2011) and 2) a human-computer interaction perspective, as found in the work of Dourish (2004)[21]. The former perspective is centralized around specific situations, in which actors engage in meaning-making through language, body and the material at hand, whereas the latter perspective is focused on designing and understanding embodied aspects of human-computer interaction.

In general, the role of the body has been foregrounded with the introduction of new digital technologies (e.g., tangible, ubiquitous and touch technologies) in both human-computer interaction (e.g., Dourish, 2004; Fogtmann, Fritsch, & Kortbek, 2008; Marshall, Antle, Hoven, & Rogers, 2013) and CSCL studies (e.g., Birchfield & Megowan-Romanowicz, 2009; Bonderup Dohn, 2009; Lymer, Ivarsson, & Lindwall, 2009; Sakr, Jewitt, & Price, 2014); however, less as a resource for members' meaning-making in technology mediated interaction. In the context of CSCL, Bonderup Dohn (2009) criticized researchers for taking a mentalist and dualistic approach when analysing and designing CSCL environments and argued that "interaction potential" is a "bodily potential". Bonderup Dohn based her theoretical position on the work of Merleau-Ponty and Gibson, and she contented "… that only given a relational, dynamic, agent-centred, and skill-relative conception of affordances can one design real learning environments for - and empirically under the interaction of - real users whose skills develop and possibilities increase as their experience gains …" (p. 169). Recently, the turn

[20] I include HCI perspectives on collaborative learning and the body, as there are several synergies between HCI and CSCL theoretically and methodologically.

[21] Dourish has since been criticised for neglecting the body and the material conditions of embodied interaction (Marshall, Antle, Hoven, & Rogers, 2013). See the special issue on "The Theory and Practice of Embodied Interaction in HCI and Interaction Design", in which Dourish, in a short paper, also reflected on his missing focus on the body in his book.

towards embodiment has been termed "third-wave HCI" (Xambó, Jewitt, & Price, 2014). Xambó, Jewitt and Price, in an HCI-learning oriented forum, argued that there is a need to explore and develop methods for understanding embodied and multisensory interaction. I will briefly introduce some of the understandings of the body, gestures and embodiment. In the international journal of CSCL (ijCSCL), at least six different understandings of body and gesture can be identified:

1. Body language (Dwyer & Suthers, 2006) and gestures (Szewkis et al., 2011) can indicate awareness between group members and student thinking (Ares, 2008).
2. A problem space, practice or discourse is continuously negotiated and established through talk and gestures (Herrmann & Kienle, 2008; Kershner, Mercer, Warwick, & Kleine Staarman, 2010; Krange & Ludvigsen, 2008)
3. Bodily orientations, such as gestures, eye gaze, etc., are part of supporting the multimodality of embodied interaction (Perit Çakır, Zemel, & Stahl, 2009).
4. The body is used as means for elaborating the artefacts under scrutiny, for example, to highlight, suggest, formulate or describe (Lymer et al., 2009).
5. Gesturing is crucial in establishing mutual alignment (Lymer et al., 2009).
6. Participants use gestures and language to communicate and develop concepts (Gómez et al., 2013) and "indexical ground for future interactions" (Evans, Feenstra, Ryon, & McNeill, 2011, p. 274).

Likewise, the term "embodiment" has been used in ijCSCL publications to stress a variety of qualities of designs, interactions or learning environments:

1. Pedagogical values, features, structures and properties can be embodied in a design for learning or in an online course (Enyedy & Hoadley, 2006; Greenhow & Belbas, 2007; Jones, Dirckinck-Holmfeld, & Lindström, 2006; Lonchamp, 2012).
2. Avatars in virtual worlds are embodied and embody virtual identities and experiences (Bennerstedt, Ivarsson, & Linderoth, 2011; Buder & Bodemer, 2008; Hung, Lim, Chen, & Koh, 2008).
3. Wegerif (2006) argued that reasoning can be located in embodied interaction.
4. Practices, artefacts, materials and physical tools can embody socially constructed knowledge and concepts, which can function as mediating artefacts for individuals and groups (Arvaja, 2007; Hakkarainen, 2009; Muukkonen & Lakkala, 2009; Öner, 2008; Ritella & Hakkarainen, 2012; Stahl, 2010; Yukawa, 2006).
5. Embodied learning is a way of expressing the role of the body in education (Birchfield & Megowan-Romanowicz, 2009).
6. Predictions and understandings are embodied (Enyedy, Danish, Delacruz, & Kumar, 2012).

What is visible from these CSCL publications is that there is little consensus or coherence among the understandings and applications of the terms and concepts of body, gesture and embodiment. Moreover, CSCL is still preoccupied with language as the one primary resource for collaboration (e.g., Dillenbourg, Järvelä, & Fischer, 2009), and it has been argued that research should, among other things, establish effective language (e.g., Crook, 1994) use for collaboration[22]. Thus, body and embodied interactions in collaborative activities seem undervalued and under-researched in CSCL. Over the years, CSCL has been occupied with interaction in online environments, but recently, focus has gradually been re-oriented towards co-located settings (Higgins, Mercier, Burd, & Hatch, 2011) and become more physical than virtual (Dillenbourg et al., 2009). This difference is also referred to as *interacting around the computer*, in contrast to *interacting through the computer* (Light & Littleton, 1999). Thus, it seems crucial to establish a methodological, theoretical and empirical base of knowledge on the body as a resource for meaning-making in CSCL.

In this brief overview of CSCL, I have tried to select and frame the particular understandings of what I find most oriented towards understanding participants' unfolding interactions in situations mediated by technology and to explore and elaborate on learning as embodied participation, action and doing. Finally, I have presented perspectives on the body, gestures and embodiment. From understandings of and in CSCL, I will turn to an ethnomethodologically informed approach to analysing processes of CSCL using video. Afterwards, I zoom in on body and hands in meaning-making. To be explicit, the following two sections offer a foundation for seeing and making visible embodied collaborative interactions.

ANALYSING PROCESSES OF CSCL

Stahl (2006, Chapter 10) suggested, as a way of rediscovering computer-supported collaborative learning, the study of what is already visible to the participants doing collaboration learning: that is, their local, witnesable rationality (Heap, 1990) in concrete, practical situations of interaction. This movement forms part of what Erickson described as "an interactional turn in educational research" (2006, p. 177), which acknowledges that learning is an interactional accomplishment taking place among the participants in context[23]. Erickson (2006), in outlining a methodological

[22] This focus on language has also instigated efforts to develop computer-automated interaction analysis tools, which can provide feedback and instructions for participants and teachers.

[23] This point was also presented by Jordan and Henderson (1995), who argued that learning is a distributed and interactional phenomenon.

overview of using video[24] to analyse classroom interaction, argued that classroom interaction is so subtle, complex and nuanced that interviews, surveys and observational checklists provide only an imprecise picture and understanding of what is taking place. Erickson (2006) devised two types of procedures for discovering and analysing video footage: an inductive and a deductive approach[25]. The latter consists roughly of developing a moment-by-moment coding of the interaction (i.e., a molar coding) based on pre-established theoretical codes, whereas the former develops detailed transcripts of situated interactions (i.e., molecular microanalysis). Here, I will be examining why the coding and counting approach to video analysis misses out on what happens between the participants, including the participants' perspectives.

From coding and counting to member's perspectives

According to Stahl (2006, Chapter 10) and Suthers (2006, p. 319), educational research has traditionally turned processes of collaborative learning into statistics, numbers and proxies covering the subtle processes of collaborative learning. Schegloff (1996) argued that "these "approaches" come to the materials of everyday life with a theoretical filter that separates the sociological wheat from the chaff, the gold from the dross, the important from the trivial, the reals from the apparent, the enduring from the transient." (1996, p. 165). This was also noticed by Lindwall (2008) and Macbeth (2002), who argued that well-defined analytical categories tend to be "looking through" and beyond the interaction actually taking place. Another critical remark in this regard was made by Streeck (1983), who pointed to the problem of going "below" what happens and of trying to figure out the psychological intentions embedded in an utterance stated by an individual. Instead of looking through, beyond and below what is happening in computer-supported collaborative learning, a part of the CSCL community has closely scrutinized the ways in which members organise and order collaboration by applying ethnomethodology and by conducting conversation analyses (CA) of collaboration in a variety of settings (Greiffenhagen, 2011; Karlsson, 2010;

[24] In the educational research field, video use was introduced in the 1970s by Frederick Erickson, Hugh Mehan and Courtney Cazden (Erickson, 2011). Erickson's (2011) autobiography portrays how video equipment at that time was heavy in both weight and price. Recently, the use of video equipment has become widespread in educational research, as technological equipment has become more affordable, accessible and mobile (Derry et al., 2010).

[25] Video analysis can be approached from a variety of methodological and theoretical perspectives. Erickson (2006) described six different theoretical approaches to video analysis, which, besides ethnomethodology, are reflected in neo-Vygotskyan theory, subject matter approaches, coding approaches, ethnography and discourse approaches and, finally, context analysis.

Koschmann, 2013; Lymer et al., 2009; Stahl, 2006). Lindwall and Lymer (2005) suggested that the analytical attitude of ethnomethodology could make educational design "move beyond unproductive generalizations and untoward use of formal analytic theory" (p. 394). Making new designs lies beyond the scope of this thesis[26]; however, the interest in understanding technology and collaboration in practical situations, which, in the future, could inform new designs, is the thesis' essence. The following two subsections will examine video analysis informed by ethnomethodology and embodied and/or multimodal video analysis of members' practices. Taking a view of computer-supported collaborative learning as embodied participation and interaction necessitates a way of seeing and making visible that seeks to explore and understand members' co-operative interactions through language and body in a practice.

Ethnomethodological input

As the title "Ethnomethodological input" indicates, this is by no means an exhaustive or in-depth presentation of the ethnomethodological tradition laid out by Garfinkel (1967). Thus, the thesis is not a discussion of ethnomethodology as such, but rather a contribution to a growing and broad selection of educational technology studies that take ethnomethodology as an inspiration and foundation for understanding educational practices mediated by technologies. To clarify, ethnomethodology has served as a way of thinking and a set of assumptions and attitudes towards the study of children's embodied interaction – an epistemological backbone of my thesis work. In the following section, some of the basic assumptions of ethnomethodology, known as Garfinkel's study policies, will be briefly outlined. These ethnomethodological assumptions have provided a basis for seeing and making visible children's embodied interaction around touchscreens. After outlining the study policies, I will look more into the embodied nature of interactions and, especially, hand movements.

Study policies from ethnomethodology

In laying out the foundations of ethnomethodology, Garfinkel (1967) devised five "study policies" (p. 32-33) for ethnomethodological research, which Koschmann, Stahl and Zemel (2007) and Stahl (2006, Chapter 18) subsumed under the headings of indifference, contingently-achieved accomplishment, relevance, accountability

[26] Button and Dourish (1998), in laying out their vision of technomethodology, stated that the objective of ethnomethodology "is in analysing practice, rather than "inventing the future". (Ibid, p. 412). Working in the fields of CSCW and HCI, Button and Dourish suggested making ethnomethodologically informed designs, taking into account the practical circumstances of users' everyday activities.

and indexicality[27]. Koschmann, Stahl and Zemel argued, and I concur, that Garfinkel's policies are useful guidelines for conducting video analysis if you are interested in understanding members' practices of doing whatever the members are engaged in. Below is a brief introduction to the five study policies related to my work.

The policy of ***indifference*** is central to my way of seeing and making visible children's embodied interactions around touchscreens, as it suggests that any social phenomenon of interest can be studied, as long as it is something that the participants treat as and make visible and reportable to each other. Moreover, and of equal importance, the policy of indifference prescribes that a single case can act as a demonstration of a particular social phenomenon. The consequence of this policy is that a single case from the video footage collected in relation to the project "Move and Learn", in which a pair interacts around a touchscreen, should be seen as a demonstration of exactly this (i.e., a moment of collaboration). As explained by Stahl (2006, Chapter 18), researchers inspired by ethnomethodology do not select *cases of x*; rather, they select situations based on what the members treat as relevant (see the policy of relevance). Consequentially, ethnomethodologists allow the members to do the analysis and interpretation of the video footage, so to speak, which stands in contrast to methods in which researchers look for pre-established categories in the data. The members are not analysing the video footage *per se*; still, ethnomethodology builds on the assumption that participants constantly analyse and interpret the actions of others and, thereby, build upon previous (other and self) actions. Their situated and ongoing interpretation is what is of interest to the researcher. As noted by Koschmann, Stahl and Zemel (2007), ethnomethodological studies seek to understand how participants produce instruction-and-learning or collaboration in context:

> In particular, any circumstance, situation or activity that participants treat as one in which instruction-and-learning is occurring can be investigated for how instruction and learning are being produced by and among participants.
>
> (Koschmann et al., 2007, p. 4)

In other words, the practical actions that the participants perform in meaning-making are of primary interest to ethnomethodological researchers, and a single case of collaboration should be treated as a demonstration of collaboration.

[27] Stahl (2006, Chapter 18) refers to the policies as indifference, inspectability, relevance, accountability and indexicality, which he translated into the claim that data for video analysis are everywhere, visible, grounded, meaningful and situated.

This leads me to the second policy, which delineates and emphasises that action is a ***contingently achieved accomplishment*** (Garfinkel, 1972, p. 304) realized by the participants of a particular and specific situation.

> It is a locally contingent phenomenon whose existence as a recognizable thing is wholly dependent on local production practices.
>
> (Garfinkel, 2002, p. 19)

This is sometimes also referred to as the documentary method, which indicates that participants are constantly making interpretations of others' actions; that is, they are constantly selecting, paying attention to, picking up, choosing, eliciting, making sense of, etc. the actions of others who are contingently coupled to the situation, activity and practical circumstances.

> Actions produce their own sense since they are designed in their achievement to be recognizable as what they are. The 'interpretation' or 'recovery' of that sense rests on co-actors' abilities to induce and infer their sense from actions themselves as they are performed/achieved locally in the circumstances of their production.
>
> (Koschmann et al., 2007, p. 5)

Goodwin (2000a) suggested that members dynamically and interactively build and sustain particular embodied participation frameworks through their actions in the environment. In particular, Goodwin proposed that context is not given, but, rather, is something configured by the participants through their interactions *in situ* and over time. This way of thinking is similar to Garfinkel's focus on "… persons who inhabit, and through their activities 'make' and 'remake' social scenes, as local production cohorts" (Garfinkel, 2002, p. 7). In Goodwin's analysis of girls playing hopscotch and archaeologists excavating a site, he illustrated that the members' activities were constituted through a range of actions, including talk-in-interaction, body movements and gestures in the specific material surroundings. This way of seeing and making visible context and action are crucial when studying children's embodied interaction around touchscreens.

Returning to the teacher's statement, "you should collaborate about this, right Julie" I argue that the teacher and the children are in the midst of producing the concept of collaboration in their local practice. In other words, collaboration was not something predefined or ready-made; it was something that was made in the practice by the particular participants in that moment of time, with the present semiotic resources at hand. As highlighted by McIlvenny (1990), analysing interaction is not a matter of understanding what is said or talked about. On the

contrary, video analysis should uncover members' methods for achieving intersubjectivity(ies)[28].

> The important point in looking at human interaction is to locate the crucial and essential local interactive processes or methods involved in the constitution of shared meaning, of achieving intersubjectivity, between actors in the practical circumstances of action and activity, rather than merely replicating a spoken 'conversation' language.
>
> (McIlvenny, 1990, p. 93)

McIlvenny pointed to a crucial interest of ethnomethodology: namely, the practical and local circumstances of actions and activities in achieving intersubjectivity, which, elsewhere, have been referred to as the taken-for-granted aspects of everyday interaction (e.g., coding and counting studies). Garfinkel (2002) commented that everyday interactional order is something to be achieved and produced by the participants; it is, in other words, not something that is there in the world ready-made.

With the third policy, ***relevance***, it is evident that what is relevant to study is not something for the researcher to decide (e.g. analyst-imposed); on the contrary, the participants show the researcher what is relevant in the situation by displaying what is relevant in their interactions, through their production and interpretation of each other's actions. Thus, context, meaning, collaboration, etc. are not things that researchers should look for based on pre-defined and fixed concepts, categories, codes, etc.; rather, they are things to be discovered in the ways participants demonstrate what is relevant in a situation and context, such as, for instance, children's co-operation around a touchscreen.

> The important point for conducting an ethnomethodologically-informed analysis (video-based or otherwise) is that it is up to the members themselves to work out through their interaction what is to be treated as relevant and it is the task of the analyst to discover what these relevancies might be.
>
> (Koschmann et al., 2007, p. 8)

For instance, Iris showed Vince[29] (and me) the relevancy of introducing a rock to cover Jesus (see Davidsen & Christiansen, 2013; Davidsen & Vanderlinde, 2014a)

[28] Linell (in press) argued that there is no such thing as one intersubjectivity between people, and suggested to use the plural form instead - intersubjectivities.

[29] Iris and Vince were in the middle of producing a multimodal video story about what happened on Good Friday (Christian religious tradition of Easter). This video story was supposed to show the outcome of their collaborative activities over four days. Prior to

through language, body movements and the material at hand. In this situation, the relationship between Iris and Vince was built around a shared interest in making a multimodal story about what happened on Good Friday. Vince was actually showing the analyst that he agreed with Iris' concern by picking up on her suggestion about making a rock. Their mutual interest and orientation towards the matter at hand served as an illustration of something becoming relevant for the participants (i.e., the members perspective) and, thereby, also of interest to the researcher.

Taking the policy of relevance seriously necessitates that the researcher focus on the visible and reportable phenomena produced by the participants in the material world with their language and their bodies. Heritage (1984) argued that members' interaction cannot be analysed by applying predefined rules, but must focus instead on the members' methods of practical reasoning as a point of departure in analysing interaction. According to Heritage, participants produce actions and recognise these actions by applying "… complex, tacit and inductively based arrays of 'considerations' and 'awarenesses'" (Heritage, 1984, p. 128). In other words, ethnomethodological studies seek to uncover the often taken-for-granted aspects of interaction – that is, the seen but unnoticed or neglected (Garfinkel, 2002, p. 259) subtleties – taking members' methods for organising a setting as the unit of analysis. In addition, the practical and common sense actions that traditional sociological work and educational research tend to treat as irrelevant or off-topic are the centre of analytic attention for the ethnomethodologist. The seen but unnoticed or neglected aspects of everyday interaction have been of crucial interest throughout my thesis, which explores seeing and making visible the subtleties of children's embodied means of collaboration.

The policy of relevance also covers the ethnomethodological stance towards validity. As argued by Lindwall and Lymer (2005), there is no "time out" from practical and mundane interaction; there is "… no privileged vantage point or method that provide a guarantee of valid results …" (p. 391). Instead, ethnomethodologically informed studies are working with another level of validity: a *praxeological* and *ecological* validity. In the final lines of the editor Anne Rawls'

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making this video story, Iris and Vince, together with classmates talked about the Christian religious tradition of Easter with the teacher Anne. Iris and Vince read about what happened on Good Friday, tested their new knowledge in a multiple-choice quiz and rewrote the story in their own words. Finally, they had to transfer their new knowledge into a multimodal video story, using the collaborative software on the touchscreen. Here, they had a collection of objects available to construct their story, but experienced that they were missing a rock to cover Jesus. Hence, they discussed the shape of the rock and the details of how to make it (see Davidsen & Christiansen, 2013; Davidsen & Vanderlinde, 2014a, for a thorough description)

footnote on page 175 in *Ethnomethodology's program – Working out Durkheim's aphorism*, Rawls contested and problematised the traditional concept of validity.

> At present validity is generally measured by the ability to manipulate methods, rather than by the adequacy of the rendering to lived experience of members.
>
> (Garfinkel, 2002, p. 175)

In other words, ethnomethodology's concept of validity is located in the dense practical and ecological configuration of the context by its members, not from the outside or from above, but in the particulars of the situated actions. The job of the researcher is, then, to locate the members' contingently achieved understandings by making visible the next turn (traditional CA)[30]. For instance, Goodwin (2000a) determined that actors do not just produce utterances on top of one another; rather, they make *relevant nexts* to coordinate the ongoing course of action, which indicates praxeological validity.

> … to establish the public, recognizable visibility of what they are doing speakers must build action that takes into account the particulars of what their addressees can and do know.
>
> (Goodwin, 2000a, p. 1492)

In other words, participants' understandings are revealed through their production of actions, both simultaneously and sequentially. Thus, the communicative work performed by the interpreter and the producer of multimodal interactions are in a relationship, in which what happens next should be seen as a sign of understanding. Enfield (2011) suggested that the work of the interpreter is shaping the relevant next of the producer, which, furthermore, actualises the study of interactions in context.

Another important element of the ethnomethodological policy of relevance is the distinction between what Garfinkel (2002) termed as *retrospective* accounts of social action and ethnomethodology's endeavour to preserve and study the details of local interaction. This distinction is similar to the say/do problem, which Blomberg, Giacomi, Mosher and Swenton-Wall (1993) encountered in their ethnographic work. In other words, as I explored in Davidsen and Vanderlinde (2014a), taking the children's perspective is not a matter of asking children what they did, but, rather, seeing and making visible how they did it in the situation.

[30] Peräkylä (2011), with regard to validity in CA, noted that the "next turn" serves as a basis for understanding the interaction playing out between the participants (e.g., how they understand each other). Besides the relevant next, Peräkylä noticed that "deviant cases" are important for obtaining valid interpretations in CA studies.

Given the fact that learning takes place in embodied interactions, retrospective accounts should be viewed as secondary accounts (Stahl, 2006, Chapter 18). Garfinkel (1972), reporting on an experiment with his students, noted that it was easier for the students to describe what a husband and wife were talking about than to report what was actually said. Whenever the students described what a husband and wife were talking about, they inferred some kind of "aboutness" not found in the actual conversation. In this way, ethnomethodology is occupied with making visible how ordinary people accomplish interaction – an occupation that literally changes how collaborative learning is understood and conceived.

The fourth study policy, ***accountability***, was used by Garfinkel to stress 1) that "… members are held responsible for their actions and are accountable for their utterances and actions; they may legitimately be called on to provide an explanation or rational …" and 2) that "… all behavior is designed in ways to give an account of the activity as an instance of something other—that is, as meaningful" (Stahl, 2006, p. 379). A basic assumption of accountability is that members are competent in what they are doing; that is, "… they are qualified to recognize (and assess) the competence of their own actions and those of other" (Koschmann et al., 2007, p. 9). Heritage (1987, p. 249) pointed out a crucial, but often taken-for-granted detail about the policy of accountability – namely, that "Social actions do not have to be baptised with language for their intelligibility and implicativeness to be available to the participants". In other words, accountability is also manifest in the body movements and manipulations of objects, tools and technologies. For example[31], when Iris and Vince decided to draw a rock to cover Jesus, Vince showed Iris his understanding of what the rock should look like; however, this was not the type of rock Iris wanted. She then gave an account of the specificities of her rock, as well as of how to use the tool to make it. In this situation, the teacher influenced the outcome of the children's discussion, but Vince accepted Iris' proposal and drew a new type of rock. Iris actually had trouble giving an account of request and specifications in language, and by using body, material and language she made an embodied account of her understanding.

The final policy, ***indexicality***, enunciates that an action or an expression "will have different interpretations or meanings depending on the circumstances in which it is produced" (Koschmann et al., 2007, p. 10). Garfinkel (1967, p. 40) noted that expressions do not have a stable identical meaning during the course of their use; rather, they change in their application of use over time and practice (e.g., "Accounts are thus *indexical expressions*" (Heritage, 1987, p. 249, italics in original)). As Heritage (1984, p. 242) outlined, (communicative) actions are both

[31] This is my "Easter-example" which is used in Davidsen and Christiansen (2013) and Davidsen and Vanderlinde (2014). The teacher's interference is not part of the transcripts in the papers.

context-shaping and context-renewing, something that is also captured in Goodwin's notion of contextual configuration (2000a). Goodwin's introduction of semiotic fields encapsulated a more holistic understanding of communication, largely because of the orientation towards more than language in human interaction. The policy of indexicality underscores that context is produced by the participants and that the participants make salient features of the environment relevant for their meaning-making. As argued by Goodwin (2000a), actors do not produce talk or actions out of thin air; instead, talk and actions are shaped to secure the orientation of the other and, in the end, establish intersubjectivity.

To sum up, the primary agenda of ethnomethodology is "… to discover the things that persons in particular situations *do*, the methods *they* use, to create the patterned level of social order" (Garfinkel, 2002, p. 6, italics in original text). This suggests that a range of methodological tools can be put into use in ethnomethodological studies. Conversation analysis has grown in prominence and has been the main research tradition for working with verbal interaction; however, in parallel, a tradition focusing on embodied interaction has developed (see, for instance the work of Charles Goodwin, 1994, 2000a, 2000c, 2007). As contested by McIlvenny (1990) and Streeck (2013), the concentration on verbal interaction and the treatment of embodied interaction as a visual phenomenon neglect the details of meaning-making through the human body and its movements. With this brief introduction to Garfinkel's ethnomethodological study policies and to the work of contemporary researchers devoted to obtaining understandings of human interaction in everyday practical situations, I will now explore and present understandings of embodied and multimodal interaction from an ethnomethodological perspective. Moreover, I will introduce a broad range of understandings of embodied interaction analysis to build a firm comprehension of what it means to make an embodied interaction analysis of members' practices.

EMBODIED AND MULTIMODAL INTERACTION

Corballlis (1999) argued that, from an evolutionary and cognitive perspective, one of the most important developments in human history happened when humans raised their bodies and freed their hands for communication and interaction. To be explicit, this development meant that the hands were no longer needed for moving the body around; instead, they could serve the role of communication and interaction with the world.[32] In addition, according to Hoffmeyer's biosemiotic perspective (2009), some of the most basic ways humans experience the world is through touching and being touched. This claim is supported by recent interaction studies; for example, Tulbert and Goodwin (2011) argued that touch is part of a

[32] This, by no means, implies that I subscribe to the idea that language emerged from gestures, a view that has been criticised and disproved by Goodwin (in press).

complex set of sign systems in American family rituals. The advent of touch technologies has inspired a great deal of interest in understanding touch as a modality (Cranny-Francis, 2011) and as a resource for meaning-making (Bezemer & Kress, in press). This development forms part of a cross-disciplinary interest and preoccupation with understanding the body in interaction and learning, which Sheets-Johnstone (2009) referred to as "the corporeal turn"[33]. Regardless, as argued by Streeck (2009, 2013), studies of the living, interacting body have been neglected "… of our entire field, from "embodied cognition" to cognitive linguistics to micro-ethnography…" (2009, p. 206). Streeck, building on the work of phenomenologists Merleau-Ponty and Sheets-Johnstone, argued that the time has come for studying and zooming in on corporeal intersubjectivity and inter-corporeality. Studying and understanding corporeal intersubjectivity calls for an embodied and multimodal analysis of interaction as it happens and is experienced by the members, which aligns with ethnomethodology's focus on verbal and nonverbal (Garfinkel, 1972) interaction and "… embodied, endogenous, witnessable practices*"* (Garfinkel, 2002, p. 7). Put differently, the environment is multimodal, and interaction is embodied per definition, but the participants highlight and make use of specific semiotic resources in the particular interactions structuring the embodied participation frameworks (Tulbert & Goodwin, 2011). Linell (2014), offering a similar position, re-inserted the human body into interaction and learning.

> In this model, the environment is not a provider of ready-made content; the sense-maker must be active in making sense of the world. A person´s mind lives in and through a body, in social interaction with others, in a world of objects, tools, artefacts, inscriptions, etc., that are made meaningful in and through an active, selective and purposive exploration of this world.
>
> (Linell, 2014, sec. 2)

Recently, Goodwin (in press, 2013) argued that humans co-operate within a situation, building on each other and the situation by inhabiting each other's interactions and bodies. With the growing interest in multimodality and embodiment in educational research (Jewitt, 2008), Garfinkel's interest in members' embodied and nonverbal interaction seems more relevant than ever in

[33] I find Sheets-Johnstone's phenomenological work on improvisational dance, in particular, interesting. In her work, she shares a descriptive account of dancing as thinking in movements (Sheets-Johnstone, 2011, Chapter 12). Moreover, taking a position quite similar to that of ethnomethodology, she is against making use of predefined annotation systems. With the expression "this evening's dance", Sheets-Johnstone makes an important remark on movement: namely, that a dance in its performance is never the same. Of course, you could say that a dance was Tchaikovsky's "Swan Lake", but the qualitative movements and the story they tell are never precisely the same.

this context. In my work with the video footage, I gradually turned towards the role of the hand in children's embodied collaboration; therefore, I want to focus on the hand both methodological and theoretically.

Hands in embodied and multimodal interaction

Norris (2004) provided a series of methodological tools for analysing multimodal discourses in interaction (e.g., modal density, levels of attention/awareness and a foreground-background continuum) and analysed a variety of situations, thereby operationalising her heuristic multimodal framework on concrete situations. Concerned primarily with delineating and describing a methodological framework for researchers to dissect, label and categorise multimodal interaction, Norris' conception of multimodality has more to do with researchers "reading" interaction than with the interaction taking place among the participants. For example, Norris wrote about the study of gestures:

> … I focus on how to discern the movement phases of gestures and how to recognize the four types: iconic, metaphoric, deictic and beat gestures.
>
> (Norris, 2004, p. 29)

Building on the work of McNeill (1992), Norris was concerned with recognising types of gestures in multimodal interaction. In contrast, an ethnomethodological approach to multimodal and embodied video analyses of hand movements is to highlight and make visible how the members engage themselves in meaning-making processes, such as looking at the role of hand movements in practical interaction (e.g., family bedtime rituals (Tulbert & Goodwin, 2011) or patient and surgeon interaction (Mirivel, 2011)). As contested by Sheets-Johnstone, "the latter language (an objective kinetic language – my edit) tying us to facts about the experience rather than leading us to a conception of its living quality or character" (Sheets-Johnstone, 2011, p. 422). Recently, Sakr, Jewitt and Price (2014) investigated children's hand movements around a tangible digital tabletop by developing and applying a taxonomy of hand movements. Again, categorising and labelling hand movements into rational categories of action (Streeck, 2013) (i.e., an objective language) abstracts the embodied interactions into something else. The separation of interaction into objective communicative modes (i.e., a system) based on the interest of the analyst or on a borrowed theory is problematic in general (e.g., looking for theoretical categories of gestures mistreats the practical circumstances under which gestures are produced in the first place). On the contrary, as originally pointed out in ethnomethodology studies, analysts "should attend to what the participants themselves are treating as important" (Streeck, Goodwin, & LeBaron, 2011a, p. 12) and omit turning the actions – talk and movement – into something outside the situation.

Another category of gesture studies claims that children express their understanding of a given phenomenon through gestures before they can express it in language (Roth, 2001). As a result, it is argued that gestures reveal what goes on in the mind. This theoretical perspective lies beyond the scope of this thesis[34], in which the focus is on what can be seen playing out between the participants (e.g., how the children use their hands as meaning-making resources, how the children orient towards each other's hand movements and how the children spatially and temporarily organise the environment with the hand movements). Instead of viewing hand and body movements (gestures) as windows to the mind or as auxiliary tools for talk, I follow and subscribe to the understanding of gestures provided by LeBaron and Koschmann.

> … they are actions that shape and help reflexively constitute a social order that cannot be separated from the understandings that interactionally emerge through teaching–learning processes.
>
> (Koschmann & LeBaron, 2002, p. 252)

Returning to the ethnomethodological input, then, multimodal and embodied interaction analyses of hand movements are occupied with the ways in which members organise and structure their interaction (Mondada, 2007) – that is, with how they inhabit the world (Goodwin, 2013). Most importantly, such analyses are concerned with how actors show, display, repair, orient, make sense, etc. in situations using the language, body and material resources at hand. Mondada (2007) also showed how pointing gestures are used to allocate turns and how gestures spatially and temporarily are part of an assemblage of multimodal resources for accomplishing (collaborative) interaction[35]. In addition, as Streeck (2009) showed, gestures are personal and context-dependent and function as resources for establishing relationships with others and with the material world.

> In general, whatever specific problem they address, gestures mediate the relationship between the individual, others, and the inhabited world, and they do so in a number of fundamentally different ways.
>
> (Streeck, 2009, p. 205)

[34] See Wilson (1999) and Blakemore and Firth (2005) for introduction to the relationship between hand movement (motoric movement) and cognitive development.

[35] Mondada (2007) made an interesting observation about pointing, namely that "(t)he very fact that she suspends her gesture but leaves her hands ready for service at short distance, shows her readiness to pursue again the same gesture, projecting a future moment where this will be relevant again." (p. 206). This is similar to my observations of some of the children's hand movements, where they sometimes do not retract their hand completely and reserves the next turn to touch the screen.

As Luff and Heath (2011) argued when reporting practices from auction houses around the world, there has been a considerable quantity of studies trying to identify the general features of gestures (e.g., iconic, metaphoric, deictic or beat gestures); however, research on environmentally coupled gestures and actions (Goodwin, 2007) in highly specialized professional institutions have been studied to a lesser extent. With the introduction of environmentally coupled gestures, Goodwin (2007) emphasised that gestures should be studied in the context of production and, even more importantly, that studies of gestures should focus on the ways members treat and interpret gestures in the sequential and simultaneous production of meaning-making. Put differently, when a participant points at something, s/he is making it relevant for "the production of meaning and action …" (Goodwin, 2000a, p. 1513). Goodwin (2000a) argued that the ways participants embody the material world and their ways of orienting and positioning themselves show what is relevant for them, which also indicates what researchers should pay close attention to in their analyses.

> … we can use the visible orientation of the participants as a spotlight to show us just those features of context that we have to come to terms with if we are to adequately describe the organization of their action.
>
> (Goodwin, 2000a, p. 1509)

The visible orientation of participants is observable through body movements, gazes, gestures, etc., which are used "to index the surroundings or to depict a world by motions of the hands are also ways of knowing these worlds and of structuring them in meaningful ways so that others can reckon with them" (Streeck, 2009, p. 203). Moreover, as argued by Streeck, gestures are part of the multimodal fabrication – a motley crew – and should not be treated as a set of well-defined or readymade movements with the hand.

> Gesture is not in the first place a code, a repertoire of conventional signs with fixed meanings and rules of use and combination. Rather, it is a form of human practice – or a family of practices – , and these practices in turn make use of a motley crew of methods and component parts.
>
> (Streeck, 2009, p. 4)

With this brief theoretical and methodological overview of embodied and multimodal interaction, and in particular the role of the hand as a resource for meaning-making, I have established a perspective, which have informed my way of seeing and making visible children's embodied collaborative interactions. In short, the outlined perspective emphasises the flexibility of the hand as an integral part in understanding children's collaborative activities around touch-screens.

SUMMARY OF THEORETICAL AND METHODOLOGICAL ENTANGLEMENTS

The intention of this chapter was to point out some of the theoretical and methodological entanglements that have proven valuable in my process of seeing and making visible children's embodied collaborative interactions around touchscreens. Moreover, this chapter serves as a way of looking forward, explicating and establishing a way of working with video footage, focusing on members' embodied, co-operative (Goodwin, 2013) meaning-making practices around touchscreens. Put differently, the chapter foregrounds and makes explicit the context of use of a way of seeing and making visible the particular mediational means and semiotic resources shaping and being shaped by children's embodied practices of co-operation around touchscreens. This is my research background.

In the history of CSCL, collaboration and cooperation have been used to stress variations of what it means to be learning together. In collaboration, the participants do an activity together; this stands in contrast to cooperation, in which participants do an activity next to each other. As I have presented and discussed, cooperation maintains and emphasises a strong orientation towards identifying the individual in the process and product of the activity, which is evident in PISA's description of collaboration. Likewise, Sennett's (2013) thoughts on cooperation as a craft also reduce cooperation to an individual skill. The notions of collaboration and cooperation have historically been used to signal a qualitative difference between togetherness and separateness while solving an assignment; however, what are we actually discussing here? It seems that the children were doing something between collaboration and cooperation. Here, Goodwin's (2013) recent work on co-operative, accumulative transformation zones – and especially the notion of co-operation – has added another layer to this old (and unproductive) dichotomy. Contrary to the individualist stance towards collaboration and cooperation, Goodwin (2013) argued that humans are actively building on each other as participants, inhabiting each other's bodies, the semiotic resources and the situation. In other words, we produce actions and utterances, not for ourselves, but for our co-participants; thus, the meanings of these actions and utterances change through our co-operative use over time (Goodwin, in press), both on a moment-to-moment basis and over larger spans of time. This way of seeing and making visible collaboration, which is outlined in Chapters 3 and 4, brings the children's co-operation in the situation under close scrutiny. When studying collaborative learning, isolating and demonstrating what the individual is doing through language and gestures is of only minimal interest; instead, what is needed is an understanding of what the pair is building together – not the products, but the situated activities of engagement and disengagement around a given technology. Recently, Majlesi and Broth (2012) introduced the term *learnables* to stress that learning opportunities are emerging in embodied interactions between teachers and students in second language learning settings. As Majlesi (2014) showed, both student and teacher build a learning

situation together through talk, embodied interaction and the materials at hand. This is an important input to CSCL, since the body, in the process of meaning-making, becomes pivotal in collaborative learning activities. Thus, participation becomes more than an exchange of utterances; rather, participation becomes embodied and social in the material world.

As noted in this chapter, CSCL studies often have an implicit focus on the role of the body as a resource for meaning-making (with the exception of, for example, Gómez et al., 2013; Lymer et al., 2009). In contrast, the way of seeing and making visible children's embodied interactions that I have outlined seeks to explore how bodies inhabit the situation and are part of the multimodal fabric of embodied, intersubjective meaning-making. I have found inspiration in the orientation of CSCL researchers Koschmann, Stahl and Suthers towards intersubjective meaning-making on a methodological, theoretical and empirical level; however, as argued by Streeck (2009) (a viewpoint with which I concur), it is time to study embodied, intersubjective meaning-making (i.e., body, touch and movement as resources for meaning-making). Historically, studies of collaboration have been oriented towards understanding and explicating effective language use in collaboration, which might also be a consequence of the studies in online virtual collaborative learning environments. Nevertheless, Streeck and Goodwin touch upon a crucial neglect in CSCL: namely, how body, language and material resources are used and how they mutually elaborate each other in collaborative activities by participants. By devoting attention to the body and its capacities for meaning-making, another approach to understanding collaboration can be described. Then, collaboration becomes an "em-bodied" skill (Streeck, 2003), and an understanding of the practicalities of embodied collaboration becomes crucial for theoretical advancements and future designs.

Before presenting my papers and discussing the difference between this way of seeing and making visible children's interaction and the approaches taken by experimental studies (Chapter 5), I will briefly reflect on the craft of doing video analysis, including a note on transcription and representation, and on the software tools used in my process of seeing and making visible children's embodied, collaborative interactions.

CHAPTER 4

Video analysis: Learning a craft

> Every use of a tool, in short, is a remembering of how to use it, which at once picks up the strands of past practice and carries them forward in current contexts. The skilled practitioner is like an accomplished storyteller whose tales are told in the practice of his craft rather than in words.
>
> (Ingold, 2011, p. 57)

> Every good craftsman conducts a dialogue between concrete practices and thinking; this dialogue evolves into sustaining habits, and these habits establish a rhythm between problem solving and problem finding. The relation between hand and head appears in domains seemingly as different as bricklaying, cooking, designing a playground, or playing the cello— but all these practices can misfire or fail to ripen. There is nothing inevitable about becoming skilled, just as there is nothing mindlessly mechanical about technique itself.
>
> (Sennett, 2008, p. 9)

Having explicated my theoretical and methodological entanglements (i.e., CSCL, ethnomethodology and embodied interaction analysis), I will now reflect on my process of learning the craft of doing video analysis by showing a historical development in my work: my building of habits. After arguing why I consider video analysis to be a craft, I make a brief note on transcription and representation; then, I outline my ways of making visible children's embodied interaction using video footage; and finally, I present the software tools I have used for transcribing children's moment-to-moment, embodied collaborative interactions from video footage. Again, I come back to Ingold's concept of "entanglements" because, in the course of my education to become a researcher, I have realised how, in almost mysterious ways, a research problem and the development of methodological and technical skills both obstruct and facilitate each other, creating a salient rhythm between problem finding and problem solving. My search for ways to work with the video footage that Marianne Georgsen and I collected in the project "Move and Learn" has allowed me to state something about how children's embodied collaborative interactions around touchscreens unfold; moreover, this process and

wayfaring has forced me to sharpen my focus for seeing and making visible – as William Blake formulated it – the world in a grain of sand[36].

SEEING AND MAKING VISIBLE CHILDREN'S EMBODIED COLLABORATIVE INTERACTIONS

A researcher occupied with obtaining understandings of human interaction based on video footage is participating in a historical, cultural and social practice (Duranti, 2006) – a professional practice and community. In addition, the tools (e.g., annotation systems and software) used for video analysis involve embedded and inherited ways of thinking about human interaction: ways of seeing and making visible human interaction. As a researcher "in the making", you are in the midst of developing and shaping a craft; you are, in fact, becoming a craftsperson – experiencing and seeing what fellow researchers do, how they do it and why they do it. This explorative process led me to experiment with different ways of transcribing and representing children's embodied interactions. Over time and through experimentation, I have gradually obtained what Goodwin (1994) refers to as professional vision: a way of seeing and making visible children's embodied collaborative interactions around touchscreens. Goodwin's (1994) analysis of the Rodney King trials is an excellent example of how a professional vision influences and highlights what is seen and (un)noticed. Through a detailed analysis of the two separate law trials, Goodwin showed how different experts, representing different professions, provided the juries with different interpretation frameworks, letting them see the previously unnoticed details of interaction. Goodwin also, in a quite powerful fashion, illustrated that the different professions made use of different "semiotic resources" to build their claims and argumentation. Another example of obtaining a professional vision (i.e., of seeing and making visible) is accounted for by Schindler (2009), who presented video footage from a material arts class in a video data session with research colleagues. To her surprise, the other participants could not see and appreciate the subtle details of the artful movements performed – the artful production of embodied meaning-making made by the artisans. The two examples have a thing in common: namely, the skill of seeing and making visible the subtle details of members' embodied and multimodal interaction in a specific context for a potential audience without any knowledge of how a body moves under certain conditions. Consequently, it can be argued that it is the researcher's task to make explicit and visible what is accomplished in a situation, based on what the members treat as relevant (see Chapter 3), and, moreover, that the researcher acquires what ethnomethodologists refer to as a unique adequacy (Garfinkel, 2002) or vulgar competency (Lindwall & Lymer, 2005); that is, the researcher must obtain

[36] "Auguries of Innocence" is a poem by William Blake – see http://en.wikipedia.org/wiki/Auguries_of_Innocence. I came across this poem during the call for papers for CSCL 2013 in Madison, WI.

a vulgar sensibility towards the context and interactions being studied without classifying the context and interactions into predefined categories. Thus, seeing and making visible the children's embodied interactions around touchscreens is a process of positioning for perception as a way of highlighting (Goodwin, 1994, 2000b) what the members treat and make relevant.

Having experienced how other researchers see and make visible human interaction from video footage, it has become clear to me that this is, in fact, a craft – not a mechanical process. It is a sociocultural and historical practice developed over time through the seeing of others' work and the finding of one's own way of seeing and making visible. In order to present my wayfaring into the practice of video analysis and, in particular, the craft of transcribing and representing children's moment-to-moment, embodied collaborative interactions, the following sections will briefly touch upon my established habits of video analysis – that is, the development of a skill into a craft.

A note on transcription and representation of video footage

A key process in the practice of doing video analysis is transcription, which can take many forms and levels depending on the researcher's interest and his/her ontological and epistemological standpoint. As the next section will portray, I have experimented with several different ways of transcribing and re-presenting; first, however, I will make some general theoretical remarks on transcription and representation. Heath, Hindmarsh and Luff (2010) argued that

> Transcription is not simply a way of presenting aspects of the activity, but provides an important resource in developing observations and getting to grips with the characteristics and organisation of the actions in which the participants engage.
>
> (Heath, Hindmarsh, & Luff, 2010, p. 67)

Thus, transcriptions are not absolute and should be viewed as an analytic resource that develops over time. Moreover, it is crucial not to treat the transcript as an ultimate final representation of the actual events; thus, it is important to continue viewing the video and refining the transcripts again and again to reflect on what they communicate. Gail Jefferson (2004), the researcher who developed the Jeffersonian transcription notation system, reflected on the process of transcription and argued that "… it seems to me that one cannot know what one will find until one finds it…" (p. 15), which is what the Norwegian anthropologist Frederik Barth said about a true anthropologist: "You want to be surprised" (as cited in Christiansen, 2010). Duranti (2006) suggested to treat transcription as a process of discovery, acknowledging that different types of inscriptions in transcription make different things salient, while backgrounding others. Duranti elaborated on Ochs'

(1979) seminal work on *the theory of transcription*, in which she, among other things, claimed and argued that transcripts are (and should be) selective. Transcripts are produced to make visible selected aspects of interaction; they are not supposed to present the whole world in all its complexity. Ochs argued that complex transcripts often distort the message that researchers want to report and convey. In unison, Duranti and Ochs suggested that transcribers should communicate the process of their transcriptions, take into account the subjects' ways of communicating and, most importantly, reflect on the choices made in the work of building transcripts (see next section). In doing so, it might be possible to uncover the intertwined process of seeing, making visible and understanding human interaction; that is, it becomes possible to start to understand the craft of video analysis.

Recently, Cowan (2014) compiled and contrasted different ways of transcribing interaction and suggested that a multimodal transcription was better suited for reporting and making visible interaction than, for instance, traditional transcripts, found in the tradition of conversation analysis. Cowan noticed that conversation analysis has gradually integrated body movements, gazes, materials, etc. in transcripts, representations and analyses and that this integration is the core focus of multimodal analysis. This might be the case of research in early childhood education (Cowan's research domain), but CA and, especially, embodied interaction analysis have been oriented towards body, language and material resources in transcripts, representations and analyses in many different settings and contexts for some decades now (see, Streeck et al., 2011a, for a historical overview). It is true that much effort has been put into making transcripts of the sequential organisation of talk in the tradition of conversation analysis, but voices in the community of embodied interaction analysis have argued that the emphasis on talk in the process and product of transcriptions and representations reinforces the mind-body split – a "lingering dualism", according to Streeck (2003). For example, and I admit having done this myself in the beginning of my work with the video footage, talk is often transcribed prior to hand and body movements (e.g., researchers approach with the idea that the interesting findings are to be located in talk). Taking talk as the starting point when transcribing and analysing embodied interaction more or less contradicts the aim of studying embodied interaction. Another tension pointed out by Streeck (2013) was that of the sequential order of interaction (primarily talk) and the simultaneous order of interaction (body movements). CA has been dealing with simultaneity in terms of making visible overlaps in talk, but in a face-to-face, tool-mediated situation, overlaps and co-occurring actions and talk are vividly present. It is not the case that just one child is gesturing and talking simultaneously around the touchscreen; instead, the children are simultaneously engaged in the situation, talking and gesturing along each other. Bolden (2003), in scrutinising single-turn collaborative completions, provided a similar argument, claiming that "… we may need to see collaborative completions not as an exclusively verbal phenomena but an action embedded within a complex

web of different meaning-making fields." (2003, p. 208). Another tension to keep in mind when transcribing and representing embodied interaction can be located in the work of Sheets-Johnstone (2011, Chapter 12), who argued that there is a difference between describing movements in wholes and in dynamic terms.

> To think in movement is not to think in monolithic comportmental wholes: eating, mating, courting, defending, aggressing, threatening, and so on; it is to think in dynamic terms – in terms of speed postural orientation, range of movement, force and direction and so on.
>
> (Sheets-Johnstone, 2011, p. 442)

Sheets-Johnstone's comment is similar to Garfinkel's comment on transcribing and representing language (Garfinkel, 1972), and it is clear that we are facing a challenge in seeing and making visible the details of embodied, collaborative, intersubjective meaning-making with text descriptions. What Garfinkel and Sheets-Johnstone suggested is that researchers should abstain from labelling, describing or presenting the subtleties of language and movement in general terms. In the following section, I outline my process of searching for a way of seeing and making visible children's moment-to-moment embodied interactions by showing the historical development of my transcriptions and representations.

From play scripts to [jeffor↑SoNIan::] transcripts to visual scripts

Duranti (2006, pp. 307–308) argued that the production of transcripts is like "… a classic hermeneutical circle, or actually a spiral, in which each loop gives us a new listening, a new viewing, exposing us to the possibility of new interpretation, which happens at a different time." In this way, I experimented with different ways of seeing and making visible the children's collaboration, depending on the story and argument that I wanted to unfold. Most of all, the process of developing the embodied and multimodal transcripts and representations was influenced by the need of finding a way of seeing and making visible children's embodied collaborative interactions. As mentioned earlier, researchers from a variety of traditions and disciplines have suggested ways of making multimodal and embodied transcripts (e.g., Cowan, 2014; Norris, 2004), however, there is little consensus regarding how best to render and make visible multimodal and embodied interaction (Heath et al., 2010).

In essence, the transcripts produced earlier in my PhD work were orientated towards what was said (i.e., they were closer to formal language representation than to the children's natural language) and summarized the children's interactions in more general expressions (e.g., they are working on a math task, they are touching the screen, she is restricting his access to the screen, etc.). For an example of some of my first ways of transcribing, see Figure 10.

Position	Person	Transskription	Tema	Kommentar
Video fra første dag – Marno og Nikoline 060410 transskription startet fra 03:56				
03:56	N	Susanne hvordan gør man lige det her		
	S	Hvad siger du		
	N	Hvordan gør man det her		
	S	Hvad var det jeg sagde det første i sku gøre det var? [Susanne peger på opgavesedlen]		
	N	Jamen vi kan ikke finde ud		
	S	Prøv at ser her		
	N	af at markere det så		
	S	Men først var det også en god ide og finde [Marno samler sine kopiark op] … den der cd…ord frem		
	N	Jamen det er også den vi prøver at finde frem		
04:16	S	Og den skal i finde frem ved at prøv at se vi skal lige have lagt den her op for oveeen [Susanne bøjer sig ind over skærmen og kører med fingeren fra højre til venstre ved skærmen]		
	M	Det er der [Marno peger på et ikon i bunden af skærmen og der åbner et vindue]		
04:36	S	Nej … det er det ikke[Marno lukker det ned], prøv at lukke den der ned [Susanne peger op i højre hjørne af skærmen] [Marno trykker på lukke-krydset og et nyt vindue kommer op] (2) nej nej bare, nej prøv lige at sige nej [Susanne trykker på nej i det vindue], prøv at ligge den ned på nederste linje bare (2) [Marno peger på et ikon i toppen af skærmen] det gør man der ja lige netop (2) og den der ligger i os ned på nederste linje [Marno gør det samme igen] (3) godt så går i ind i den runde her ned [Susanne peger på windows-ikonet]		

Figure 10 - Play script of children's interactions (in Danish)

Here, I used a template in MS Word™, with columns for time, person, transcript, theme and comments, which I had used for transcribing interviews in other projects. The precision of this transcript was vague, and it presented the children's and teachers' talk and action in very general statements (i.e., as "monolithic comportmental wholes" (Sheets-Johnstone, 2011, p. 442)). Here, I used square brackets to indicate actions, and the transcript showed no signs of overlaps, concurrent talk or interaction. In a similar fashion, Davidsen and Georgsen (2010a) used a very traditional and textual transcription method to represent how children engaged in the collaborative activity. Overall, this type of transcription resembles what Erickson characterised as "play-scripts" (2011), which easily could have been handled by transcribers other than the researchers themselves. In addition, this way of transcribing represented the participants' utterances as small monologues – not as an evolving interactive dialogue.

(0.5)

1. I: °så'en er det

I: ° that's it

(2.5)

2. V: lød det ik fint¿

V: did'nt it sound fine ¿

3. I: JOEW men det er fordi vi har ik no'en hule vi ka læg ham ind-en sten vi ka °læg hen foran

I: YESS but it is because we have dont have a cave we can put him in-a stone-can ° we put in front

(2.5)

4. V: JEG ka tegn det (.) NEJ VI KA TEGN DET jo

V: I can draw it (.) NO WE CAN DRAW IT course

5. I: ja det kan vi jo (0.3) men ehmm han er bar lig neden for neden-NEJ ik såen: (1) nej vi tegner ik såen

I: yes, we can (0.3) but ehmm he is in the field below -NO NOT like that: (1) No we do not represent it like that

(0:15:45.3)

6. V: nårh hvordan så ¿

V: then how so ¿

Figure 11 - Iris and Vince, Version 1

As I mentioned in Chapter 1, a crucial change happened during my PhD as a consequence of the obstacles faced in different PhD courses[37]; in preparing for

[37] The PhD courses "Acting with Technology", taught by Ellen Christiansen, Pirkko Raudaskoski and Trine Heinemann at Aalborg University, and "Video Analysis in the

conference presentations; and, especially, in my experience of getting acquainted with ethnomethodology (Garfinkel, 1967), embodied interaction analysis (Streeck et al., 2011b) and the Jeffersonian transcript system[38]. Moreover, as I will reflect upon in the next section, my work with different software tools for transcription led me towards a more detailed way of transcribing, representing and analysing children's embodied interaction.

Above, in Figure 11, a first version of the transcription and representation of my Easter example with Iris and Vince is presented. This was a first attempt to make visible how children's naturally occurring talk was produced using an established annotation system. This first version of my Easter example excluded hand and body movements, while trying to present the children's naturally occurring talk. However, as I experienced how hand and body movements played a crucial role in the children's collaborative activities and, in particular, in the children's bodily co-operation (Goodwin, 2013) around touchscreens, I developed a transcription and representation practice that focused, of course, on language, but also on the body and the material resources and settings at hand. Many experiments led me to this visual way of transcribing and representing (see Figure 12, page 60) the children's embodied meaning-making process, as reported in Davidsen and Christiansen (2013) and Davidsen and Vanderlinde (2014a). Here, I came to use an automatic frame-grabbing software[39] to extract each frame of a 22-second-long video, which I, in turn, made into series of photos of the evolving bodily and visual interaction. This photo stream made it possible to analyse the sequential and simultaneous embodied interactions of the children. Basically, I was searching for a method that would enable me to see and make visible the sequential and simultaneous interactions: the children's movement towards the touchscreen, their retraction from the touchscreen, their hands overlapping and their gestures away from the screen. In other words, I was searching for a way of seeing and making visible the children's moment-to-moment, embodied collaborative interactions. On top of that, I described the children's hand and body movements in text boxes above the photos. Here, I tried to follow the suggestions of Sheets-Johnstone when describing movement; that is, I described movement "… in dynamic terms – in terms of speed postural orientation, range of movement, force and direction and so on " (2011, p. 442). Finally, I placed children's utterances in speech bubbles in the photos. While I

Learning Sciences", taught by Oskar Lindwall and Jonas Ivarsson at Gothenburg University, in particular, influenced my way of transcribing and representing video footage.

[38] I was partly introduced to the Jeffersonian transcript system as I was acquainted with the hotkeys in Transana (Woods & Fassnacht, 2013).

[39] Free video to JPG converter: http://www.dvdvideosoft.com/products/dvd/Free-Video-to-JPG-Converter.htm

consider this way of transcribing and representing embodied interaction to be better, the quality of the pictures was not completely satisfying.

The most recent experiment of seeing and making visible children's embodied interaction around touchscreens is found in Figure 13 (page 61) and in Davidsen and Christiansen (in press). Here, selected frame grabs were turned into pencil drawings using Adobe Illustrator™ to highlight the children's bodies and, in particular, their hand movements around the touchscreens. Like in the representation in Figure 12, the children's movements were described above the series of photos, while their talk was made visible in speech bubbles. The pencil drawings made the subtleties of the children's hand and body movements more visible[40] for the readers to see and understand.

In summary, transcribing and representing embodied and multimodal interaction is an endeavour full of the dangers of doing abstract, categorical and theoretically informed transcriptions (especially analyses) of the practical interactions carried out by participants. Once again Ingold's concept of "entanglements" (2007, 2011) helped me understand how my realisation process was taking shape: it was my wish to better understand how hand and body movements unfolded in the children's collaborative activities that forced me to explore new methodological lines and technical skills. Thus, in my way of seeing and making visible children's embodied collaborative interactions, I have tried to overcome the focus on language as the one resource for collaboration and, instead, focus on the simultaneous, naturally occurring hand and body movements. In addition, I have sought to describe the children's hand and body movements in a neutral language and to couple this language with the visible conduct on the relevant photos. Of course, the richness of video footage is not done complete justice in transcripts; thus, it is important to stick to the original video footage to analyse what is actually taking place in the members' ways of arranging and organising interactions.

[40] Late in the process of writing this thesis, I became acquainted with Scott McCloud's work on making and understanding cartoons (McCloud, 1993, 2006), which I think could be useful in future representations of embodied interaction.

(Iris turns her head, gazes towards Vince with her left elbow on the table (frame 26-30))
(Vince' moves his left hand towards his upper torso grabing the headset line, then he snaps twice with his left hand (frame 28-29)) (Iris strethes out her index finger on her left hand (frame 30))

(Iris holds that position (frame 30-35) while (Vince positions his left hand on the table (frame 31-34)

(Iris leans slowly forward towards the screen - the body follows her finger – and moves the scrollbar up and as a consequence the figure of Jesus disappears from the screen (frame 36-39))
(Vince lifts both his hands up to his head and lifts the headset from his ears twice, but ends up letting it sit on his head (frame 36-40))

Figure 12 - Iris and Vince, Version 2

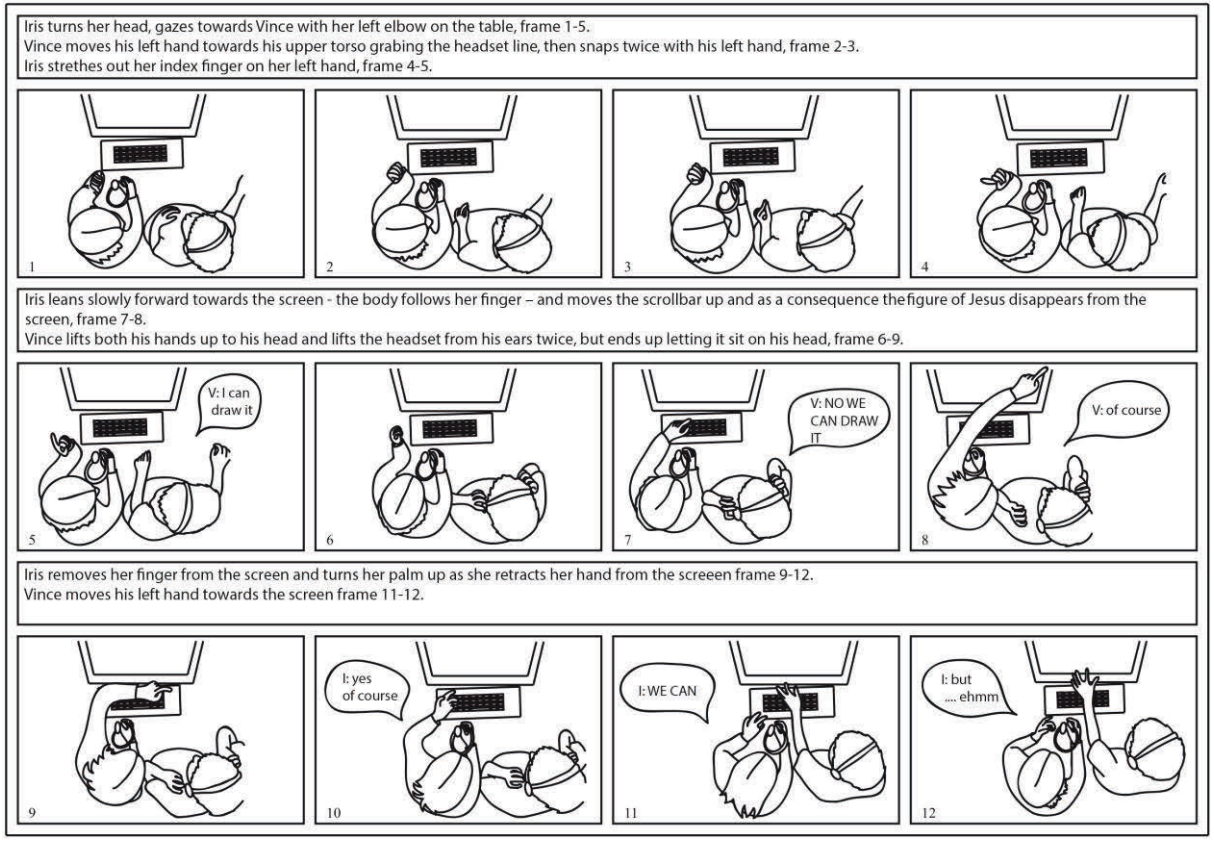

Figure 13 - Iris and Vince, Version 3

Software for transcription: Transana and ELAN

There is a broad and growing range of software tools available for conducting video analysis in all phases of research projects. In my project, the initial transcripts were made in a word document. Then, I experimented with Nvivo™ but realised that a tool for working exclusively with video was needed. Hence, I decided to work with Transana (Woods & Fassnacht, 2013), and later, I began using ELAN (Max Planck Institute for Psycholinguistics, 2013) in my process of working with video footage[41]. I would like to comment that each and every tool is built upon certain beliefs and understandings of human interaction, which structure the ways in which it is possible to work with video footage within the program and, to some extent, the outcome of the work. In what follows, I reflect on the features of the programs Transana and ELAN, which have proven useful in my process of seeing and making visible children's embodied interactions.

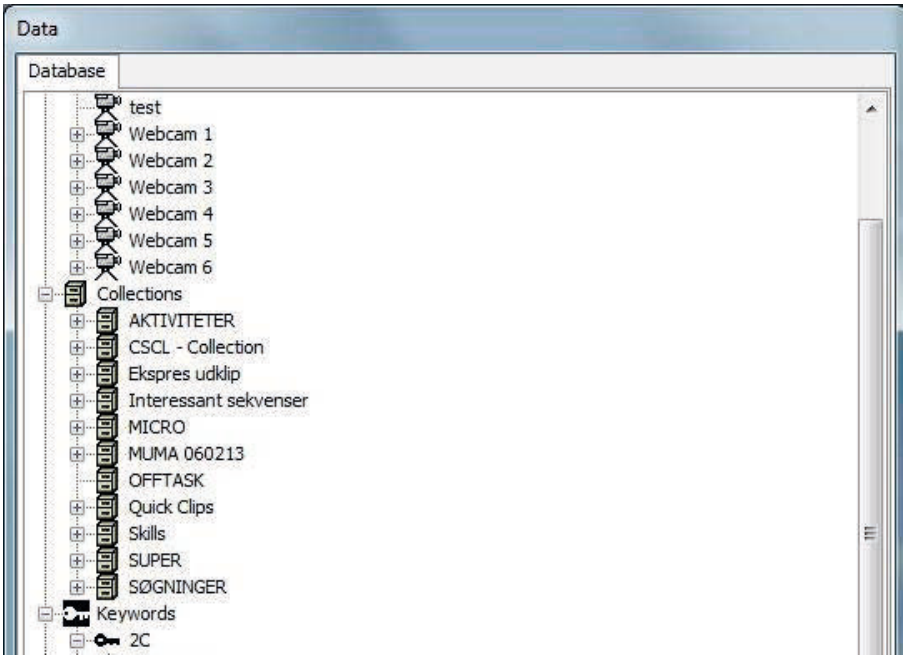

Figure 14 - Overview of data and collections in Transana (in Danish)

[41] For presentations, I have subtitled the video extracts using InqScribe™ (http://www.inqscribe.com/).

In Transana, the whole collection of video footage was organised and systematised, and some initial draft transcripts were produced, primarily as play-scripts (Erickson, 2011) and logs of the unfolding of the events. Organising and systematising the video footage in Transana consisted of labelling and categorising every video with the names of the children and teachers, the genders of the pairs and the subject of the specific lesson (see Figure 14). After this, I systematically looked through every video from classroom X, for instance, searching for situations in which a teacher guided a pair around a touchscreen. This resulted in a preliminary collection of 248 clips of teachers guiding pairs on social, technical and subject-related themes. This collection in Transana provided a foundation for the future analysis of interactions in the classrooms on several levels of granularity. However, Transana offered limited support with regard to the detailed analysis of embodied interaction[42], and I decided to experiment with ELAN for the fine-grained transcripts. Instead of pointing out the limitations of Transana, I will introduce how I developed a method for transcribing in ELAN[43]. ELAN offers a detailed and fine-grained construction of transcripts; however, it is also, in many ways, more complex than Transana and more difficult to learn to operate. In ELAN, I started with a simple transcript template focused on language (e.g., a transcript tier for each participant). Gradually, I developed a transcript template with "tiers" for talk, right and left hand movements, body movements and computer interaction[44] (see Figure 15). In ELAN, I especially used the functions for playing the video frame by frame (Ctrl + ←/→[45]) and for zooming in on the children's hand movements around the touchscreen. The option to play the video frame by frame served to highlight how the children engaged in interaction through their bodies. Moreover, playing the video footage frame by frame made the talk of the children temporarily invisible, while making their body and hand movements more prominent. This process led to the finding of Iris's and Vince's hand movements, which I had not noticed before (see Davidsen & Christiansen, 2013; Davidsen & Vanderlinde, 2014a).

[42] During my work with the video footage in Transana, the developers of the software gradually integrated functions for making more multimodal transcriptions in Transana (e.g., photos and the ability to draw on photos in the most recent version).

[43] In the process of moving my draft transcripts from Transana to ELAN, I found and made use of Transformer (http://www.oliverehmer.de/transformer/). Transformer makes it possible to transfer and modify transcripts between a range of software programs, including Transana and ELAN, among others. Transformer, in my opinion, makes it possible to get the best of many worlds when it comes to software transcription tools.

[44] For another usage of ELAN see Evans, Feenstra, Ryon and McNeill (2011), who coded multimodal discourses in ELAN.

[45] Ctrl + ←/→ is one of the shortcuts in ELAN that I have used extensively in the process of segmentation.

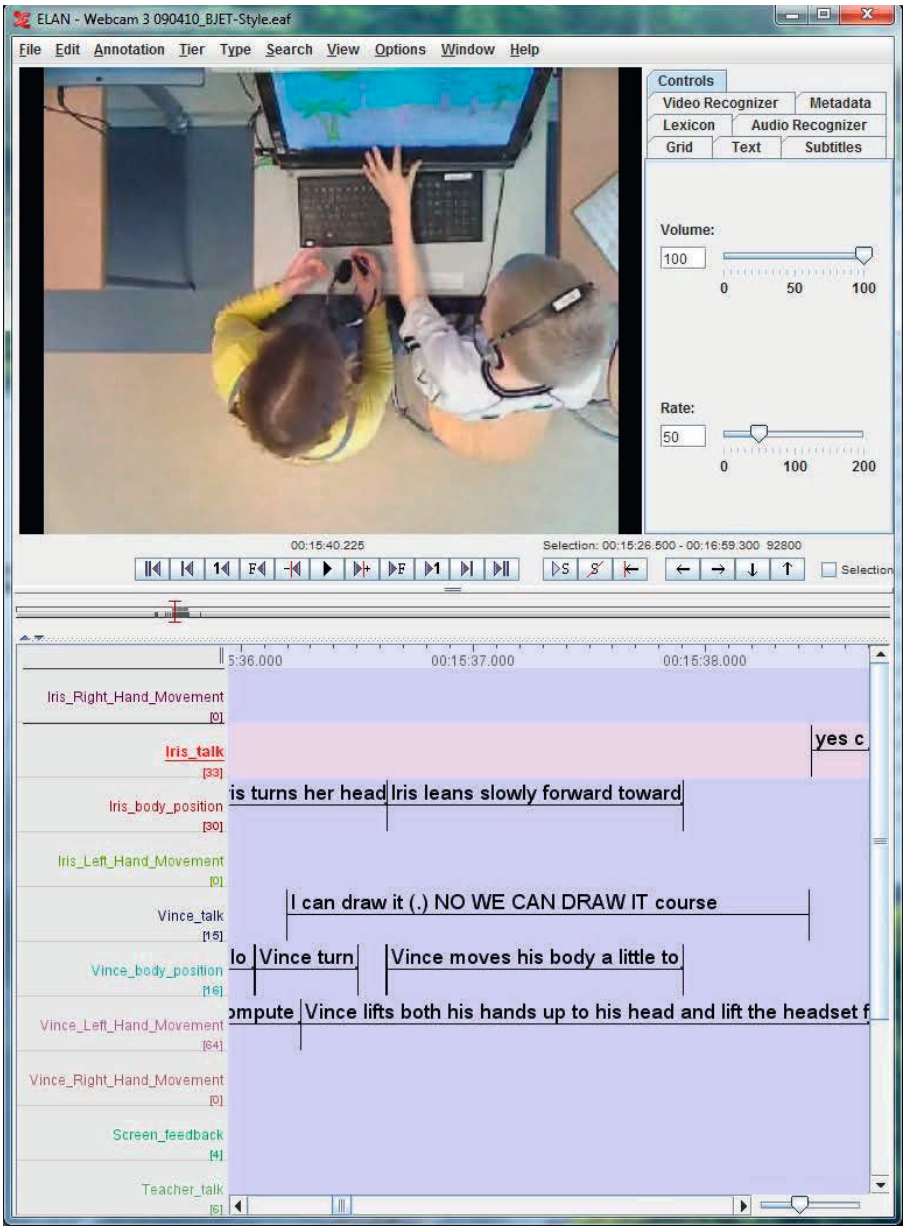

Figure 15 - Transcript template in ELAN

ELAN offered a way to watch video footage and to see the children's body and hand movements unfold on a detailed level. This has served as the basis for my work with multimodal representations (see Figure 12 and 13). Zoom, on the other

hand, granted access to a close analysis of what the children were doing around and upon the screen. Sometimes, when in doubt of the gestures performed on the screen, I loaded the material that the children were working with onto my own computer. For instance, I was unsure about what Vince was doing on the touchscreen (drawing a circle around the rock he had just made) until I tried it myself. Then, I experienced that drawing a circle around an object erased what was inside, which made me understand Vince's action differently. Streeck, Goodwin and LeBaron (2011a, p. 13) referred to this as cognitive ethnography, which underscores that the "analyst's ability to understand the relevance of the movements of the participants' bodies requires thorough knowledge of both the environment that is the focus of their concern, (…) and of the embodied actions that habitually occur within the environment". Gradually, I integrated the different work modes in ELAN, especially the segmentation mode and the transcription mode. While the segmentation mode offers a fast and precise "cutting" of the video footage, the transcription mode offers a fast way of transcribing. Of course, I jumped between these two steps in developing the transcript to make adjustments and refinements, (following the essence of the statement, "it seems to me that one cannot know what one will find until one finds it" (Jefferson, 2004, p. 15)).

Learning to use ELAN was time consuming but rewarding in the sense of being able to work with the video footage at a micro-detailed level. The accuracy and precision offered in seeing and making visible is one of the biggest differences between Transana and ELAN. Moreover, the feature of making separate transcription tiers for each individual, their talk and body movement turned out to be a fruitful way of segmenting and making visible the children's embodied collaborative interactions for myself. I am, by no means, arguing that you can or should separate talk and body movements when analysing embodied interactions, but in order to grasp how the children used their hands as a communicative resource, the segmentation proved useful.

SUMMARY OF LEARNING A CRAFT

Developing a craft like embodied and multimodal video analysis is a process of experimentation and continuous refinement, one of doing, discovering and reflecting again and again. I have showed my process of developing a method for seeing and making visible children's embodied, moment-to-moment collaborative interactions informed by ethnomethodology and embodied interaction analysis. There are many instructions, guidelines, tools and systems for making transcriptions and representations, but in the end, it is like a craft in the skilled hands of the researcher. As commented by Ingold "… while the instruction was supposed to tell you how to move, one could only make sense of it once the movement had been accomplished" (2000, pp. 357–358). Over time, I have developed an embodied practice for using ELAN to transcribe children's interactions, and I have come to view ELAN as an integral part of my analytical process. I am not arguing that my

approach fits all researchers and research purposes, but I have nonetheless provided an overview of my journey into embodied interaction analysis that may serve as a foundation for future discussions and explorations. Building on my theoretical, methodological and practical background, I will now present a brief overview of how children's collaborative learning supported by touchscreens has been studied.

CHAPTER 5

Touchscreens and collaborative learning – An overview

So far, I have provided an overview of the case, my methodological and theoretical entanglements, and how I have developed a practice of seeing and making visible children's embodied collaborative interactions. Now, I want to look more closely at how research on touchscreens and collaboration has been conducted and on what can be communicated on this basis. Afterwards, I will summarise and reflect on what my research papers contribute to the existing research literature – that is, what my way of seeing and making visible tells about children's collaboration around touchscreens.

In order to structure the review of studies on collaborative learning around touchscreens, I divide the papers of relevance into the three general types of studies identified by Stahl, Koschmann and Suthers (2006): 1) experimental and conditional studies, 2) iterative design studies and 3) descriptive studies. On an overall basis, the different studies can be subsumed as in Table 1:

	Design studies	**Experimental and conditional studies**	**Descriptive studies**
Setting	Known/unknown	Laboratory	Natural setting (classroom, workplace, etc.)
Users	Hypothetical	Selected	Natives (teachers, children, etc.)
Research method	Design theory/method	Testing, counting and coding	Descriptive (video) analysis
Concept of affordances	Designer's knowledge and ideas	Theoretical assumptions and hypothesis testing	Articulated through situated and practical use

Table 1 – Overview of research approaches in CSCL

So far, research on collaborative learning around touchscreens and tabletops has been approached primarily from the first two approaches; however, as will be presented in Chapter 6, my contribution to this research domain is offering a set of descriptive studies. There are a number of differences between the specific

functions of the touchscreens in the different studies presented below (e.g. vertical or horizontal, multi-touch or single-touch, consumer or prototype); nevertheless, each and every study revolves around an ambition of coming to an understanding of the affordances of touch technology for collaborative learning.[46]

EXPERIMENTAL STUDIES OF TOUCHSCREENS

Some of the experimental and conditional studies on interactive multi-touch tabletops have suggested that this kind of technology can support collaboration, more equal forms of participation, scientific inquiry and more speedy conflict resolution (Hornecker, Marshall, Dalton, & Rogers, 2008; Rick, Marshall, & Yuill, 2011; Sakr et al., 2014). For example, Rick et al. (2011) presented work on three dyads working with DigiTile in the back of a classroom in sessions lasting 30 minutes each. The researchers instructed the children on how the tabletop worked and then interviewed the children during the sessions. Rick et al. (2011) built on the common belief about the affordances of interactive tabletops: namely, awareness of each other's actions and concurrent, parallel work. As a final perspective in their work with the DimondTouch table and DigiTile, they suggested that enforcing equitable physical participation can disrupt the dynamics of collaborative activities. Besides these more general characteristics provided by the experimental and conditional studies, I have identified three strands of studies: 1) comparison studies, 2) lab-classroom studies and 3) gesture studies.

A strand of experimental studies has compared the collaborative behaviour of children around multi-touch tabletops with their behaviour around other technology. For instance, Harris et al (2009) reported a difference between multi- and single-touch-technologies and concluded that, in the single-touch setting, children talked more about turn taking, while, in the multi-touch setting, talk was oriented more towards the task at hand. In this experimental setting, the children were asked to make a seating plan for their classroom based on information about the different pupil groups in order to make the seating plan successful. Harris et al. used the tabletop for only "a short period of time in the classrooms" (Harris et al., 2009, p. 343) and reported that the children were excited to be able to work with the technology. Another comparison study was performed by Higgins, Mercier, Burd and Joyce-Gibbons (2011), who compared how the same task was solved using a multi-touch table and paper and suggested that the use of multi-touch tables better promotes the creation of a joint problem space in collaborative learning tasks. These results were based on the quantity of touches and the types of utterances (Higgins et al., 2011). In a later study, Mercier and Higgins (2014) suggested that

[46] Recently, researchers from, for instance, literacy studies have investigated whether iPads can be used as a learning resource (e.g., Sandvik, Smørdal, & Østerud, 2012). This is, however, not a part of the focus in my inquiry into related studies here.

multi-touch tabletops can augment children's reasoning and representation in groups, based on experiments with 48 students, aged 10 to 11, from six different schools. Having video recorded the interactions of the groups, Mercier and Higgins coded every 30 seconds of video footage based on two coding schemes: one for determining reasoning levels and one for classifying tabletop use. Based on their coding and counting of the children's reasoning and interaction with the multi-touch tabletop, Mercier and Higgens concluded that multi-touch tabletops can potentially support complex collaborative learning activities in classrooms.

Another strand of experimental and conditional studies focuses on finding out how touchscreens can be implemented in an overall classroom pedagogy and on finding ways of giving teachers pedagogical tools for orchestrating classroom interaction (Kharrufa, Martinez-Maldonado, Kay, & Olivier, 2013). These studies are often conducted in what Mercier and Higgins (2014) referred to as "lab-classrooms": settings resembling a real classroom, with several tabletops for groups of students and a teacher tabletop for controlling and monitoring the groups. Acknowledging the importance of nonverbal and verbal interactions in co-located collaborative learning activities, Martinez-Maldonado, Dimitriadis, Martinez-Monés, Kay and Yacef (2013) developed a system for automatically capturing talk and physical actions on a touchscreen with video equipment, screen capturing software and a 3D body scanner. With this complex data set, the authors pointed out that "the less collaborative groups had a predomination of patterns with physical interactions, high levels of physical concurrency and greater parallelism than the more collaborative groups." (p. 481), while "…the more collaborative groups had more verbal discussions in conjunction with physical actions…" (p. 481). These results, which are based on the automatic collection of numbers and statistics, are meant to help teachers in obtaining and scaffolding children's collaborative activities.

The final strand of studies is oriented towards understanding children's gestures around tabletops. For instance, Sakr, Jewitt and Price (2014) inquired into the semiotic work of hands in a tangible, digital tabletop setting with pairs of 10- to 11-year-old students. The authors studied ten pairs, who used the LightTable – a tangible tabletop – for 20 minutes each. The aim of the paper was to describe how a tangible tabletop application can support inquiry into a scientific problem and, in particular, to find out what role hands play in this inquiry. By applying and extending the work of Roth (2002), Sakr, Jewitt and Price proposed a taxonomy of hand actions, which provided a vocabulary for finding and understanding the role of hands in children's science inquiry around tabletops.

In total, the strands of experimental and conditional studies have been oriented towards understanding the affordances of touchscreens for collaborative learning in lab-classrooms by coding, counting and abstracting the children's talk and actions into statistics, categories and taxonomies. Hence, it seems fair to state that these studies do not understand, in a practical manner, how children's moment-to-

moment embodied collaboration around touchscreens unfolds or how teachers can obtain a professional vision regarding collaborative learning around touchscreens.

DESIGNING FOR TOUCHSCREEN COLLABORATION

From a design-oriented approach, Yuill and Rogers (2012), Dillenbourg and Evans (2011) and Scott, Grant and Mandryk (2003), to name a few, have presented guidelines supporting the integration of touch technologies in collaborative learning settings. I will briefly extract the main points from each of these design studies.

Scott, Grant and Mandryk (2003), some of the first to address the design of tabletops for collaborative learning, devised eight system guidelines for co-located collaborative work on tabletops. Among other things, they suggest that the technology should support natural interpersonal interaction, flexible user arrangements and simultaneous user interactions.

In a more recent paper, Dillenbourg and Evans (2011), in addressing the design and implementation of touch technologies for teaching, proposed 33 points for consideration when integrating touch tables into educational settings. Despite Dillenbourg and Evans' emphasis that "God lies in the details" and their excellent inspection of the affordances of touch technologies, they did not move to the deeper levels of what touch technologies offer for embodied, intersubjective meaning-making in collaborative activities.

The third design framework, outlined by Yuill and Rogers (2012), draws on social psychological theories of learning to identify three mechanisms that influence collaborative learning. These three mechanisms are: 1) high awareness of others' actions and intentions, 2) high control of the interface, and 3) high availability of background information. According to Yuill and Rogers, these mechanisms are present in everyday interaction and involve mutuality between participants. In their evaluation of existing designs and design guidelines, Yuill and Rogers suggested that constraints on these mechanisms help people interact. Additionally, Yuill and Rogers (2012) criticized the commonly perceived affordances of how the "natural" interaction with touch technologies influences participation and collaboration in positive ways.

In summary, these design-related studies present a mixture of abstract and concrete guidelines based on theoretical positions and beliefs about collaboration, interaction and learning.

SUMMARY OF OVERVIEW

With this overview of related ways of seeing and making visible collaborative learning around touchscreens, it becomes clear that the experimental and conditional studies were designed to test the affordances of the different tabletops and software applications – not the children's autonomous and everyday practical methods of using the technology in their collaborative activities in their classroom. In many ways, these studies resemble many characteristics of usability testing (Sharp, Rogers, & Preece, 2007). Thus, the experimental and conditional studies, which coded and counted children's interactions, turned the children's embodied collaborative interactions into something different – something abstracted from the children's worlds. To be explicit, the children's meaning-making and, especially, their embodied, intersubjective meaning-making was unnoticed by researchers as a cause of their methodological and theoretical orientations and traditions. I acknowledge the results and hypothesis testing found in the related studies; however, on the basis of my theoretical and methodological entanglements, I think a complementary perspective is needed: a perspective that provides findings and knowledge about the subtle details of children's embodied collaborative interactions around touchscreens. In other words, while the related studies have presented dramatic differences in the level of collaboration around touchscreens by contrasting statistical accounts, I propose an examination of what the children actually say and do together through their language and bodies around the touchscreens. Basically, I am suggesting that CSCL needs a theoretical and a methodological perspective, incorporating sensibilities towards the particular technology in use and the embodied collaborative interactions unfolding. In other words, I propose that descriptive studies of children's bodily intersubjective meaning-making can shed light on what touchscreens can offer children's collaborative activities. Thus, the aim of this thesis was to uncover children's embodied methods in collaborative activities around touchscreens and to see their worlds from their perspective. In the following chapter, I will summarise and reflect on the papers and the development of my way of seeing and making visible children's embodied collaborative interactions around touchscreens. The five papers, both individually and collectively, contribute descriptive accounts of children's embodied engagement and disengagement in collaborative activities. In addition, the papers (especially Papers III and IV) explore how researchers and teachers can learn together about children's collaborative activities around touchscreens using video footage.

CHAPTER 6

Summarising and reflecting on the papers

Leaving the related studies and their findings based on coding and counting collaborative interactions, I will now summarise, comment and reflect on my research papers. Each of the papers portrays lines of my entanglements (Ingold, 2007) on the journey of understanding how children's embodied collaborative interactions around touchscreens unfold – empirically, theoretically and methodologically. Reflecting on these papers, it is apparent to me that they fall into two groups: Papers I, II and V deal with the children's moment-to-moment, embodied collaborative interactions around touchscreens, while Papers III and IV deal with the methodological aspects of using embodied and multimodal video analysis as a tool for informing teachers about children's collaboration around touchscreens and, moreover, how video analysis can be used as a tool for capturing children's perspectives. In Chapter 1, I mentioned the emergent character of the unit of analysis and, in the following, I will summarise how the research papers, one by one, directed me towards seeing children's hand and body movements as crucial communicative resources in their embodied collaborative interactions.

PAPER I: ICT AS A TOOL FOR COLLABORATION IN THE CLASSROOM – CHALLENGES AND LESSONS LEARNED

In this paper, written together with Marianne Georgsen, the project "Move and Learn" was introduced, along with some of the lessons learned from following this technology integration project for one year. Further, by analysing a short video clip with a boy and girl collaborating around a touchscreen, the ways in which children's collaboration in front of touchscreens can unfold were demonstrated and questions regarding how teachers can teach collaborative skills in classroom settings were formulated. Our reflections in this paper were informed by Clark's notion of common ground (1996) and by Neale, Carrol and Rosson's (2004) formulation of interaction levels, which was derived from CSCW research. At the time of writing the paper, it was quite clear to me that the levels of interaction defined by Neale, Carrol and Rosson, as well as Clark's participant types, were useful in labelling and understanding the children's interactions. However, after becoming acquainted with ethnomethodology and embodied interaction analysis, I found that these theoretical labels no longer facilitated my understanding of the children's embodied collaborative interactions around touchscreens. In addition, as pointed out by Koschmann and LeBaron (2003), Clark's concept of common ground is problematic, since it instantiates that there is something like a shared world, or a shared established cognition. Nevertheless, the overall theoretical alignment with the concept of intersubjectivity in this paper, as outlined by Matusov (1996, 2001) and Wertsch (1984), is also part of my theoretical scope in

Papers II and III. My interest in intersubjectivity led me towards an interest in the children's embodied meaning-making. Linell (2014) suggested the use of the term intersubjectivity in the plural (i.e., intersubjectivities) to underscore that actors do not have or share the same intersubjectivity. Furthermore, Linell argued that intersubjectivies are built through both language and body in the material world, together with other people. We do not experience the world alone, but together. This position has informed my way of seeing and making visible children's moment-to-moment embodied interactions.

Thus, the outcome of working with this paper was an increased awareness of the necessity of making explicit what collaboration actually refers to in classroom practices. I realised that collaboration, in the context of the project "Move and Learn", was not a predefined or ready-made concept present in the teachers' pedagogy or their digital learning materials. In this context, collaboration was something that needed to be negotiated among the children and between the children and the teachers each and every time of use (Firth, 1995) (e.g., an add-on to the configuration of the traditional classroom installation (Macbeth, 2000)). Moreover, it became clear that placing digital learning technology in classroom settings also demands and, partly, fosters new roles for both teachers and pupils. Finally, reflecting on the paper, it is clear to me that, at the time of its writing, I was only beginning to realise that touchscreens are different from other digital learning tools.

PAPER II: THE BENEFITS OF SINGLE-TOUCHSCREENS IN INTERSUBJECTIVE MEANING MAKING

This paper, written together with Ellen Christiansen, connected and related to existing studies of children's collaborative learning around touchscreens. These studies have primarily been conducted as what Stahl, Koschmann and Suthers (2006) referred to as experimental, conditional and design studies. By applying embodied interaction analysis to a 22-second-long excerpt (my Easter example) of Iris and Vince collaborating, we discussed, analysed and explored the benefits of single-touchscreens for intersubjective meaning-making. This analysis was informed by Suthers' (2006) idea of studying a technology's affordances for intersubjective meaning-making. Suthers argued that "… the joint composition of interpretations is the gist of intersubjective meaning-making" (2006, p. 321). Thus, children's practices around a technology become the central subject of the analysis, which, according to Suthers, moves the analytic foci from the intentional act of learning to the interactional accomplishment of the situation. Whereas Suthers treated intersubjectivity as a language phenomenon and, in part, as a matter of reification and interpretation, I focus on the children's embodied, intersubjective meaning-making. Thus, the children's embodied co-operative building of the situation (Goodwin, 2013) is what should be the gist of the analysis of intersubjectivity. In other words, where I focused on the children's verbal

interaction in the beginning (see Chapters 3 and 4), I gradually changed my analytic foci towards their embodied practices. This movement was partly instigated by my discovery of Sheets-Johnstone's (2009) phenomenological work on the body and by my familiarisation with the field of embodied interaction analysis (Streeck et al., 2011b) (see Chapters 3 and 4).

One of the ambitions of this paper was to discuss whether a seemingly old technology has something to offer children's embodied collaborative interactions. Put differently, the paper's goal was to explore and understand how children use a single-touchscreen in their process of embodied, intersubjective meaning-making. The analysis of Iris and Vince's process of coming to an understanding and an agreement regarding how to draw a rock to cover Jesus[47] showed how they built and interpreted the situation through hand movements, gaze orientations, manipulation of the touchscreen and language co-operation. At the same time, they displayed their understanding of what it means to collaborate through their use of the pronoun "we" and their gestural invitations for the other to act. The 22-second-long video extract shows how eight- and nine-year-old children competently manage the complex process of embodied intersubjective meaning-making around touchscreens. Iris and Vince showed me what it means to be collaborating through body and language. This descriptive micro-study of children's embodied intersubjective meaning-making around touchscreens showed that technology, in itself, does not contain the power to scaffold or afford collaboration; on the contrary, collaboration is something to be learned by children – something teachers have to integrate in materials, instruction and feedback.

The paper presents the outcome of my detailed analysis, which is, in itself, a methodological step forward. This – my first experience of the power of micro-detailed analysis of children's embodied interactions around touchscreens – intrigued me and encouraged me to continue and refine my work with detailed analysis as part of my research competence. The process (see Chapters 3 and 4) of coming to see and make visible the children's embodied practices served as the basis for my interest in ethnomethodology and embodied interaction analysis on a more general level. At the same time, this analysis marked a shift of focus in the problem formulation for my research: from technology to collaboration. Of course, I do not forget that the introduction of new digital learning technologies – in this case, shared touchscreens – is the foundation behind my research. Nor do I leave out the mediating technology from my analysis. However, from this point onwards, I see the digital learning technologies – old or new – as only part of the learning environment, and my unit of analysis becomes the children's interaction with each other, the touchscreen and the learning environment, some of which, in

[47] Iris and Vince were working with the Christian religious tradition of Easter and the story about Good Friday.

Heidergerrian terms, are ready-to-hand, while others are present-at-hand (Dourish, 2004; Winograd & Flores, 1986) in ways that change from moment to moment. This is what has motivated my work through the micro-analytical approach I have followed since.

PAPER III: EXPLORING WHAT TOUCHSCREENS OFFER FROM THE PERSPECTIVE OF CHILDREN: METHODOLOGICAL CHALLENGES

In this paper, written together with Ruben Vanderlinde, two methodological challenges were explored and discussed. First, the challenge of taking a children's perspective was presented and discussed through the analysis of a short excerpt. Second, the methodological challenge of how researchers can inform teachers' designs for activities and materials relating to children's collaboration with ICT was described. In dealing with the first challenge, the same situation analysed in Paper II was used; however, each paper has its own distinctive focus and research question. In Paper II, I discussed what single-touchscreens offer intersubjective meaning-making, whereas, in Paper III, I explored and discussed how researchers' methodologies can take children's perspectives and use micro-analyses to inform teachers' practices. Using what I have come to call my "Easter example" in several papers may seem to be "overuse", but I am inspired by Charles Goodwin, who has used his hopscotch example[48] in several papers (e.g., 1994, 2000a) because it illustrates different aspects of micro-analytic studies and human sociality.

Selwyn, Potter and Cranmer (2010) argued that children's perspectives are needed in educational technology research literature and used children's drawings as a means to give children a voice in the technology integration debate. In contrast, this paper applied an embodied and multimodal analysis of children's interaction. Overall, this paper accounts for my attempts to explore and understand children's perspectives by following the traditions of ethnomethodology and embodied interaction analysis. Basically, as argued in the paper, there is a difference between making children, or people in general, reflect on their use of a technology or how they acted in a situation and studying how they actually use that technology or act in that situation. Ethnographers of work refer to this as the say/do problem (Blomberg et al., 1993), and ethnomethodologists distinguish between anecdotes of interaction and studies of interaction (Garfinkel, 1972). Thus, this paper presents my exploration of what a micro-analytic embodied and multimodal perspective can tell about the children's perspective on the use of touchscreens in classrooms. In addition, I showed how educational technology researchers can research *with*

[48] During a recent seminar with Charles Goodwin and Marjorie H. Goodwin at Aalborg University, I learned that the hopscotch example is actually from a Marjorie Goodwin project.

children rather than *on* children (Christensen & James, 2008), obtaining an understanding of children's worlds – of their means of interaction and "cultures of communication" (Christensen, 2004, p. 170).

The second challenge – how researchers can inform teacher's designs for activities and materials relating to children's collaboration with ICT – was briefly touched upon through a reflection on the process and outcome of the video feedback sessions. Thus, the paper suggests that interaction analysis can be used as a means to support teachers' understanding of what happens in their classrooms. In Paper IV, this idea is taken up and discussed more in depth.

Regarding my research journey, the outcome of doing the analysis for this paper was an increased interest in the difference between asking participants what they did and analysing their naturally occurring interaction from video footage. Moreover, the work of obtaining children's perspectives on their interaction consolidated my shift towards ethnomethodology and embodied interaction analysis, and the outcomes of dealing with the second challenge provided the basis for Paper IV.

PAPER IV: RESEARCHERS AND TEACHERS LEARNING TOGETHER AND FROM EACH OTHER USING VIDEO-BASED MULTIMODAL ANALYSIS

In Paper IV, also written together with Ruben Vanderlinde, I explored and discussed how video-based multimodal analysis of children's use of touchscreens can facilitate mutual learning processes for teachers and researchers. By describing the steps taken in the processes of analysing the video footage and of conducting video feedback sessions with the teachers, this paper exemplified how researchers and teachers can learn together and from each other using video-based interaction analysis. In the paper, three usages of ICT were presented: "(1) as a tool for children's collaborative learning; (2) as a tool for researchers to collect, analyse and present data; and (3) as a tool for facilitating teachers' understanding of their practice by using video-based multimodal analysis" (Davidsen & Vanderlinde, 2014b, p. 453). In particular, the paper focused on the second and third methods. The second way of using ICT presented my process of using Transana (Woods & Fassnacht, 2013) and ELAN (Max Planck Institute for Psycholinguistics, 2013) to transcribe the children's embodied interaction. Hence, the paper also contributed a practical dimension of using software to transcribe video footage. The third application of ICT delineated the process of organising and conducting video feedback sessions between the researchers and the teachers.

Seeing and making visible computer-supported collaborative learning has traditionally been a concern for researchers; however, this paper outlined, explored

and discussed the process of making visible the subtleties of embodied collaborative interaction as a mutual learning process between teachers and researchers. Inspired by ethnomethodology, the researchers did not evaluate how the children's collaboration unfolded or how the teachers guided the children's collaborative activities during the video feedback sessions; rather, they sought to inform the teachers' way of seeing their own practice by making them "evaluate" the interactions taking place based on their own experience, knowledge and beliefs as teachers and members of the practice. Basically, the video feedback sessions conducted in relation to the project "Move and Learn" served as a way to obtain what Stahl (2006, Chapter 18) referred to as intersubjective validity, which refers to researchers validating their interpretations with the participants in order to make sure that both parties see the same phenomenon. In addition, as Hester and Francis (2000, p. 7) contended, "…it is through such detailed inquiries that 'self-reflection' and hence improved practice may best be promoted"; this was exactly what was experienced in the video feedback sessions with the teachers. The teachers addressed the benefits of participating in the video feedback sessions through post-reflective blog posts and participation in the video feedback sessions, which made their learning outcomes visible.

The outcome reported in this paper was a methodological account of how researchers and teachers can learn together and from each other using multimodal video analysis. Moreover, the process of using Transana and ELAN for seeing and making visible children's collaboration around touchscreens was presented and discussed. This way of working together with teachers (i.e., members) inspired me to always involve members in seeing and making visible the subtleties of their practice.

PAPER V: MIND THE HAND: A STUDY ON CHILDREN'S EMBODIED AND MULTIMODAL COLLABORATIVE LEARNING AROUND TOUCHSCREENS

This paper, written together with Ellen Christiansen, was meant as a contribution to the recent focus and interest in multimodal aspects of learning and collaboration from within different educational research traditions (Jewitt, 2008). Hence, the paper moved beyond the interest of "defining effective language use in this context …"(Crook, 1994, p. 123) and built on the assumption that "*meaning is created across the utterances of different people*" (Stahl, 2006, p. 6 , italics in original); thus, it explored and analysed the embodied nature of eight- and nine-year-old pairs of children collaborating around touchscreens. The paper was written during the final half year of my PhD period and was influenced by my growing interest in explicating a way of seeing and making visible children's moment-to-moment embodied interactions around touchscreens. The intention of the paper was to move beyond the ability to touch the screen and to provide a detailed, embodied and

multimodal analysis of children's bodily, intersubjective meaning-making practices around single-touchscreens. In other words, rather than treating the touchscreen as the *one* resource for collaboration, I began treating it as a semiotic resource among many.

The paper presented an analysis of how three different pairs from the project "Move and Learn" engaged in activities around touchscreens. It was argued that children can use their hands to "constrain and control, to construct and problem solve, and to show and imitate" (Davidsen & Christiansen, in press). Thus, the analysis contributed to the understanding of embodied and multimodal aspects of collaborative learning around touchscreens. The focus on the hand was invoked by the findings from related papers, in which the work of the hand was turned into either numbers or abstract categories of hand gestures (Sakr et al., 2014). In addition, as suggested in the paper, it seems of critically importance to analyse the children's interaction around the touchscreen, not just their actions on the screen surface. In other words, it is crucial to explore and understand how children use their hands – and all the other communicative resources – to build practices of embodied, intersubjective meaning-making.

In this paper, Goodwin's (2013) notion of co-operation was also used to stress that the children were building upon each other's actions while inhabiting the situation, mutually monitoring how their activity unfolded. Goodwin, in his development of the concept of "co-operation", furthermore stressed that humans are not just *in* a situation; rather, they transform and accumulate the possibilities provided by their predecessors. In a similar vein, Linell (2014) argued that humans are positioned in an ecosocial world, which provides what Linell refers to as *content* for meaning-making. Unlike the terms *cooperation* and *collaboration*, Goodwin's *co-operation* focuses and zooms in on the mutual operation of the situation through language, body and tool use. In other words, the unfolding actions of the children are constituted through their contributions through diverse semiotic resources; that is, a child operates based on what the other is doing and on what is provided by the predecessors. Thereby, children build the situated action together (Goodwin, in press, 2000a, 2013). This level of analysis seems crucial in obtaining an understanding of children's embodied collaborative interactions. The outcome of this paper was an understanding of how children co-operatively engaged and disengaged in collaborative activities around touchscreens, with special attention paid to the role of their hands.

SUMMARY OF MY CONTRIBUTIONS

In summary, these papers contribute three main points regarding how children's embodied collaborative interactions around touchscreens unfold, which are the following:

1. Children use their hands to engage and disengage in the collaborative activities around touchscreens and to build corporal and embodied intersubjective meaning-making.
2. Children contingently monitor, co-operate and interpret the situation, actions and semiotic resources together in front of touchscreens and build and treat the situation as collaborative.
3. Children competently co-operate and inhabit the moment-to-moment situations, building complex and accumulative methods of engaging and disengaging in collaboration around touchscreens.

These contributions are contextualised and situated in the research fields of CSCL@school, ethnomethodology and embodied interaction analysis. In addition, my contributions point to certain theoretical and methodological perspectives regarding embodied and multimodal video analysis:

- Embodied and multimodal video analysis of children's collaboration around touchscreens offers a children's perspective that pertains to their worlds and their means of interaction. This perspective allows researchers and teachers to understand how children actually engage and disengage themselves in collaboration around touchscreens. By exploring and developing different techniques for representing the children's embodied collaboration around touchscreens (see Chapter 4), the thesis also contributes a portfolio of representational techniques of children's interaction around touchscreens.
- In practice, collaboration is not a ready-made and predefined concept, and touchscreens are, by no means, natural tools for supporting collaboration. On the contrary, collaboration is developed, recognized, nurtured, established, etc. over time by the children through contingently performed embodied actions.
- Embodied and multimodal micro-analysis can reveal to teachers the unnoticed and subtle details of children's collaboration, which have proven useful to teachers' emergent understanding of how pairs engage and disengage in collaboration and in the teachers' design of learning materials for collaboration.

To align the lines of my wayfaring of becoming a researcher of embodied collaborative interaction around technologies, let me summarise how the five papers that I have selected for my dissertation contribute: I became acquainted with my data while collecting them, well before I began my journey to become a researcher. My first path was the video footage Marianne Georgsen and I collected and on which I reported, emphasising that much more happens in a classroom than in controlled lab experiments and that this "much more" was worth investigating

(Paper I). The next path was my way into embodied interaction analysis (Paper II): here, the issue of identifying the most relevant unit of analysis turned into a crucial activity, which led me to see the importance of identifying and being analytically aware of whose perspective and what story the transcripts, representations and analyses highlighted and made visible. This, in turn, made me realise that the exchange of perspectives between researchers and practitioners, mediated by collaborative video-watching, was a powerful tool for facilitating mutual learning and for improving teachers' professional visions (Papers III and IV). Finally, as demonstrated in Paper V, I have arrived at what seems to be solid ground: my focus on the role of the free hands in the embodied collaborative interaction process and on a unit of analysis comprising collaborating children and the learning environment, including digital technologies, materials and teachers/more capable peers. Methodologically, all of these lines of wayfaring come down to a video-ethnographic approach informed by ethnomethodology and embodied interaction analysis.

CHAPTER 7

All along those lines

The teacher Anne said, "*you should collaborate about this, right Julie"* and since that moment, I have been interested in understanding, seeing and making visible children's embodied practices and methods of engaging and disengaging in collaborative activities in front of and around touchscreens in classrooms. Seeing this situation and the situations analysed in the papers again and again, made clear to me that there were no external rules governing the concept of collaboration in this practice and no magical fix embedded in the technology *per se*. This made clear to me that rules or norms of collaboration have to be negotiated and interpreted in every occasion of use. Likewise, although touchscreens are believed to be the perfect fit for multiuser activities, they do not offer clear-cut affordances for collaboration; that is, touchscreens open possibilities for embodied collaborative interactions, but the integration of touchscreens into classrooms does not necessarily promote collaborative processes. This is visible in my papers, where I have showed examples of children's everyday practices and methods for engaging and disengaging in embodied collaborative interactions around touchscreens.

Stahl, Koschmann and Suthers (2006) declared that "we must understand in more detail how small groups of learners construct shared meaning using various artefacts or media" (2006, p. 10) in order to design for collaborative learning supported by computers. This thesis, my contribution to CSCL, offers descriptive accounts of children's moment-to-moment embodied interactions around touchscreens, which, in the future, could inform the practice and design of touchscreens for collaborative learning. Building on insights from CSCL, ethnomethodology and embodied interaction analysis, I offer a situated, relational and embodied way of seeing and making visible children's embodied collaborative interactions around touchscreens. This way of seeing and making visible centres on how children – through language and their bodies in the material world – engage and disengage in embodied, intercorporeal, intersubjective meaning-making around touchscreens. In other words, figuring out what the teacher meant when using the word *collaboration* requires an analysis of how the children related to this term/concept – that is, their actions to show each other how they understood the suggestion made by the teacher. Thus, in conclusion, the micro-studies of children's embodied collaborative interactions around touchscreens suggest that researchers and teachers need to understand the embodied co-operative nature of collaborative learning, moving the level of analysis from understanding children's collaboration to understanding children's embodied co-operation. This also necessitates a holistic and relational view on technology, in which children gradually embody the touchscreens as a tool for engaging and disengaging in collaborative activities.

In Part 1, the meta-reflective commentary of my thesis, the children's free hand movements around touchscreens have been established as a crucial difference in collaborative settings. I argue that studying children's hand and body movements around touchscreens can contribute in important ways to a better understanding of how children engage and disengage in collaborative activities, and not just around touchscreens. That is not to say that language should be given a less prominent place in understanding collaboration; rather, it is a motivation to analyse and understand how children – with their hands – co-operatively inhabit the touchscreen and situation, thus showing each other what it means to be collaborating.

This close-knit tissue (to use Ingold's term (2011, p. 84)) of winding and irregular lines has reached a dwelling spot: a theoretical and methodological stance, building on my entanglements with CSCL, ethnomethodology and embodied interaction analysis. On this basis, I have explored how children's embodied collaborative interactions unfold and, in addition, I have accounted for my process of coming to see and make visible the children's means of embodied collaboration.

FURTHER RESEARCH ALONG THESE LINES

The embryo of this thesis feeds into the research field of CSCL@school and, in particular, into research on multiuser technology in classroom settings and the development of methodologies for qualitative studies of video data. As a part of writing Part 1 of the thesis, I have pointed out possible future lines to follow in my academic wayfaring into and around CSCL. I want to briefly point to three of these new lines of research, which I would particularly like to explore in the future: 1) the role of the body in learning with computers as instruments, 2) children's methods for disengaging in collaboration and 3) the unfolding of the children's embodied co-operative actions over time. In some ways, these lines also point to some of the limitations of my thesis work and to shortcomings in present research agendas:

In recent years, touch-based technologies have stimulated great hopes for education and learning because of their ease of use and intuitive interface; however, based on the descriptive studies in this thesis, I argue that future research should concentrate on the embodied aspects of using touch-based technologies to judge and establish the affordances of this technology for collaboration and to pay more attention to learning about appropriate digital technologies as tools of learning – a research stream from which the ease-of-use discourse tends to steal attention. More specifically, following the lines of Goodwin (2013) into the moment-to-moment embodied co-operative nature of collaboration. I think there is a lot more to learn about children's embodied co-operation around touchscreens that laboratory studies focused on coding and counting behaviour do not notice. It is not just about taking the human perspective in design or evaluation; rather, it is about taking the human body seriously as a meaning-making resource in the design and evaluation of CSCL environments. I have only partly explored the modes of touch and movement in this

thesis; however, having learned the craft of embodied interaction analysis, I am certain that this is a research area that I will be pursuing in the future. Embodied repair work around touchscreens would be a most interesting topic to explore in future research, since it affords the opportunity to understand the subtle details of collaboration – the embodied "collaborative completions" (Bolden, 2003).

Second, I see potential for research in understanding children's methods for disengaging in collaborative activities in more depth. I have touched upon the children's ways of disengaging in collaborative activities in Papers I and V, but, while writing Part 1, I have become increasingly interested in understanding the subtle, embodied details of children's methods for disengaging in collaborative activities. Here, we may find a source to understand better how to design for collaboration and how teachers can refine their methods for instructing and guiding children's collaborative activities.

The third line of research I want to pursue is the historical unfolding of the children's embodied collaborative actions over time. In the papers, I have scrutinised situations of embodied collaborative actions; however, it would be of great interest to see and make visible how a pair or different children engage in collaboration over time. For instance, future research should study changes in the children's ways of doing collaboration and how their participation in collaboration over time shapes their identities as peers in collaborative activities. In other words, I wish to scrutinise how children's embodied interactions change over time and whether they collaborate differently depending on the pair constellation. Moreover, the teachers in the two different classrooms applied different strategies for coupling the children; thus, it would be interesting to explore whether this has any consequences for the children's collaborative actions in the two classrooms over time.

OUTRO – ZOOMING OUT

In an increasingly computerised and networked world, collaboration and ICT skills are believed to be essential for children's learning (OECD, 2013). Being skilled in using technology and collaborating has been identified as central in becoming a good citizen and (global) worker in the future. To promote and instigate a global interest in teaching ICT and collaboration skills, The Organisation for Economic Co-operation and Development (OECD) will begin testing children's collaborative problem solving skills in 2015. The test will be oriented towards establishing individuals' collaboration levels through a computer-based test system. Setting aside the rather superficial testing situation, OECD's conception of collaboration is problematic, especially considering the grounds of this thesis. OECD uses statement like "… pooling their knowledge, skills and efforts …" (p. 4), "… the capacity of the individual …" (p. 4) and "… communicating the right information and reporting what actions have been taken to the right person at the right time …" (p. 6).

Thereby, OECD is, first of all, taking an individualistic attitude towards collaboration; second, OECD is stating that knowledge, skills and efforts are things that simply can be shared; and third, OECD is suggesting that collaboration is all about communicating the right information at the right time to the right person. Underneath these expressions and assumptions is a theory that communication and interaction are straightforward processes among a homogenous language group using a formal ideal language (Linell, 2014). Moreover, there is an idea that language is the only means for engaging in collaboration. OECD maintains and follows a tradition in which the ultimate goal of collaboration is having a shared understanding of the problem. In this line of reasoning, there is *one* shared problem and *one* common understanding to be achieved. There is no arbitration in ways of doing, no uncertainty and no different meanings to be explored.

Whether we like it or not, OECD will begin testing children's collaborative problem solving skills in 2015. However, it seems of critical importance to problematise OECD's assumptions about collaboration. As argued throughout this thesis, collaboration is embodied, and children co-operatively build meaningful situations with present and situated semiotic resources. This does not imply that they have the same understanding of the problem. The goal of collaboration is, thus, not to obtain a common understanding or ground, but to produce or make something in common.

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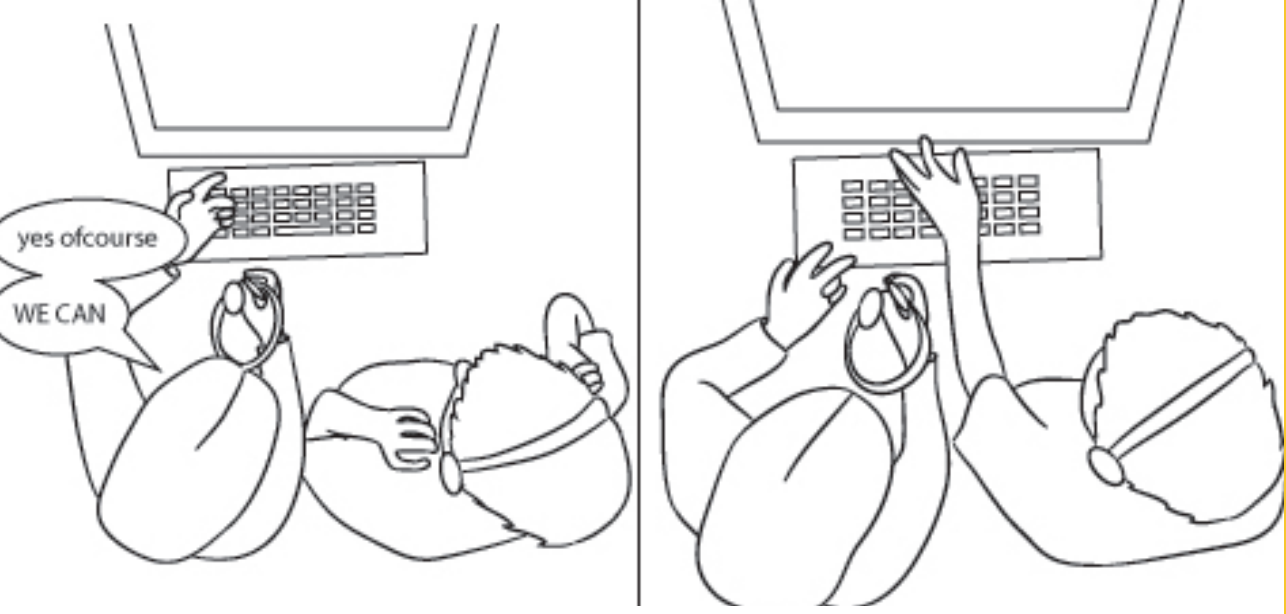

RESUMÉ

In “Second graders’ collaborative learning around touchscreens in their classroom”, Jacob Davidsen explores, analyses and discusses how eight- and nine-year-old children’s embodied collaborative interactions around touchscreens unfold in classroom settings. Having conducted micro-studies on children’s embodied interactions around touchscreens, the author has found that children’s body movements and, in particular, their hand movements are crucial in their processes of engagement and disengagement in collaborative activities around touchscreens. The data comprise 150 hours of video footage and ethnographic observations, all from a year-long study of naturally occurring activities in two second grade classrooms at a public school in Denmark.

The way of seeing and making visible children’s collaboration around touchscreens presented in this thesis is informed by CSCL, ethnomethodology and embodied interaction analysis. The findings provided by this way of seeing and making visible can have implications for researchers, teachers and policy makers, with regard to their understanding of children’s collaborative activities around touchscreens. The research is part of the field of CSCL@school, and the micro-studies contribute findings regarding children’s embodied practices of moment-to-moment co-operation of collaborative activities around touchscreens.

ISSN: 2246-123X
ISBN: 978-87-7112-155-1

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